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CHANGE OF ASTRONOMICAL TIME.

By H. C. WILSON.

With the beginning of the year 1925 a change in astronomical time will probably be adopted in all the countries where astronomical research is carried on, making the astronomical day agree with the civil day, i. e. begin at midnight instead of noon. The change has been urged for many years and among the astronomers in charge of the preparation of the nautical almanacs and ephemerides of the various countries an international agreement was secured on the subject a few years ago.

The reason for the two kinds of time was formerly that astronomical observations were for the most part made during the night, so that it was more convenient and there was less danger of confusion if the date were continuous through the night, while civil operations were mostly confined to day time and it was more convenient to have the date changed at night.

With the multiplication of both civil and astronomical transactions during the last half century, and their extension through both day and night, the advantages of the different time reckoning have disappeared. The change is more easily made in the astronomical than in the civil day, affecting a much smaller group of people. It is necessary to change only the twenty-four hour clocks, which are mostly confined to the observatories, setting them ahead twelve hours. Sidereal clocks need not be changed.

Astronomers engaged in research on problems involving dates preceding and following January 1, 1925, will need to be on their guard to take account of the omitted half day.

The predictions of phenomena, ephemerides of the planets, comets, and variable stars, where the hour of the day is necessary, from now on will be made in civil time and observers should bear that fact in mind when using the tables which we print monthly in POPULAR ASTRONOMY. To avoid printing A. M. and P. M. with the numerous predictions we shall use the 24-hour notation, the hours from 0 to 12 occurring in the first half of the day (A. M.), and the hours from 12 to 24 in the second half of the day (P. M.).

For the most part it will be most convenient to use Greenwich Civil Time. The reader can easily change Greenwich time to Standard time by subtracting (adding if east of Greenwich) the number of hours of his Standard time zone. For example, a minimum of Algol is predicted

for January 14 18^h Greenwich Civil time; an observer in the Eastern Standard time zone should subtract 5 hours, making the predicted time of minimum January 14 13^h, which is the same as January 14 1^h P. M. The minimum predicted for January 6 4^h, to an observer in the Central Standard time zone will occur 2 hours before midnight, or January 5 22^h, which is the same as January 5 10^h P. M.

THE ECLIPSE OF JANUARY 24, 1925.

By H. C. WILSON.

The total eclipse of the sun which will occur on the 24th of this month will be unique in that it passes over the most thickly settled part of the United States. There will be many amateurs who will be able to witness the eclipse without leaving their homes. There are also several well equipped observatories within the path of totality. These will afford to professional astronomers in those localities opportunities which are granted to individuals less than once in a lifetime. The central line of the path of the moon's shadow passes over or very close to the observatories at Cornell University, Vassar College, Wesleyan University, Yale University and Nantucket Island. The University of Toronto is within the path of totality but about forty miles north of the central line. The Municipal Observatory at Duluth is just at the southern edge of the path of the shadow, with the sun at an altitude of only 2° at the time of totality.

On account of the probability of bad weather in the winter season the professional astronomers will be gathered mostly at the established observatories in New York and Connecticut. It is important therefore that amateurs all along the path of the total eclipse should do all that they can to obtain records of the phenomena of the eclipse, for clouds and inclement weather may prevent observations at the few established observatories.

From the reports which will be given later, the reader will notice that the most western station likely to be occupied is that at Bayfield, Wisconsin, where the Goodsell Observatory party will be stationed. The Yerkes Observatory will send a small expedition to a point near Iron Mountain, in Michigan just north of the Wisconsin boundary. Parties from the University of Toronto and the Dominion Observatory will both be stationed near Hamilton, at the west end of Lake Ontario. Harvard College Observatory will have a small party at some point in western New York. At Ithaca, New York, will be the party of the Fuertes Observatory, at its own location. Astronomers from Smith and Yerkes Observatories will be located at Vassar College, Poughkeepsie, New York. Parties from the Harvard Astronomical Laboratory, McCormick Observatory, Ladd Observatory, Washburn Observa-

tory and Mt. Wilson Observatory, will be located at the Van Vleck Observatory, Middletown, Connecticut. Astronomers from the Allegheny, Sproul, Wellesley and Yale Observatories will be at New Haven, Connecticut. A small party from Harvard, and possibly one from Wellesley, will be located at the Maria Mitchell Observatory on Nantucket Island.

A new feature of eclipse observing will be the use of the United States navy dirigible Los Angeles, for carrying observers from the United States Naval Observatory, with cameras for photographing the corona, out into the path of the eclipse over the Atlantic Ocean.

What can the amateur do? Perhaps some suggestions may be obtained from the following list of things which are to be done by the professional astronomers.

1. Observe the times of contact of the moon with the edge of the sun's disk.
2. Photograph the corona with ordinary plates and with plates sensitive to different colors of light. For the latter the camera must be provided with an appropriate color filter.
3. Photograph the spectrum of the corona with ordinary plates and with those sensitive to different colors.
4. Photograph the flash spectrum just as the sun's light vanishes and reappears.
5. Determine the motion of the corona with etalon interferometers.
6. Study the polarization of the corona.
7. Make photometric observations determining the brightness of the corona.
8. Measure the coronal radiation with vacuum thermocouple.
9. Observe the flash spectrum and coronal and chromospheric rings with field-glasses fitted with replica gratings.
10. Make observations determining the effect of the eclipse on magnetic and wireless instruments.
11. Observe the shadow bands visually.
12. Photograph the shadow bands.
13. Take moving pictures of the eclipse and corona.
14. Take moving pictures of the flash spectrum.

Some of these observations can be best made at the physical laboratories, of which many lie along the path of the total eclipse, where the light of the sun can be thrown into fixed spectroscopes in the laboratory. Observers who are situated at the edge of the path of the moon's shadow will have much better opportunity for studying the flash spectrum than those nearer the central line, for the phenomenon will last only two or three seconds near the central line but may be prolonged to even a minute or more at the edge of the path. The shadow bands, too, are likely to last longer near the edge than along the central line of the path of totality.

The amateur should not be discouraged by the lack of a telescope

from taking photographs of the corona, for it is possible to make a comparatively long focus camera with very simple lenses. By taking out one of the two lenses of an ordinary large size camera and inserting the tube carrying the other lens in a light-tight wooden box, one can make a camera of twice the ordinary length. Suggestions for such cameras are given by Mr. J. H. Worthington and by Mr. E. A. Fath in articles in the May, 1924, number of POPULAR ASTRONOMY.

For photographing the shadow bands the camera should be of very short focus with a very rapid lens. In order to see the shadow bands, which are rather vague and hazy, a large sheet of white cloth should be stretched upon the ground, or, possibly better, inclined at an angle of from 30° to 45°, so that the camera may be better focused upon it. The exposure should be very short.

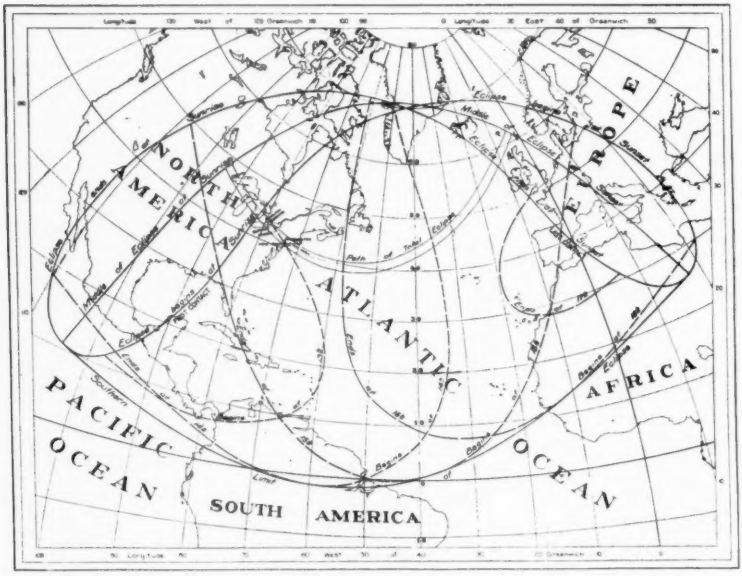


FIG. 1. DIAGRAM OF THE TOTAL SOLAR ECLIPSE OF JANUARY 24, 1925.
The hours of beginning and end are expressed in Greenwich Civil Time.

The accompanying diagrams will show to the reader the area over which the eclipse will be partial, covering the greater part of North America, the Atlantic Ocean, the eastern part of Europe and Africa. The path of totality crosses the northeastern part of the United States, curves upward across the Atlantic Ocean and ends just north of Scotland. The larger diagram shows the portion of the path of totality which crosses the United States, beginning about 150 miles northwest of Duluth, Minnesota, running east-southeastward across northern Wis-

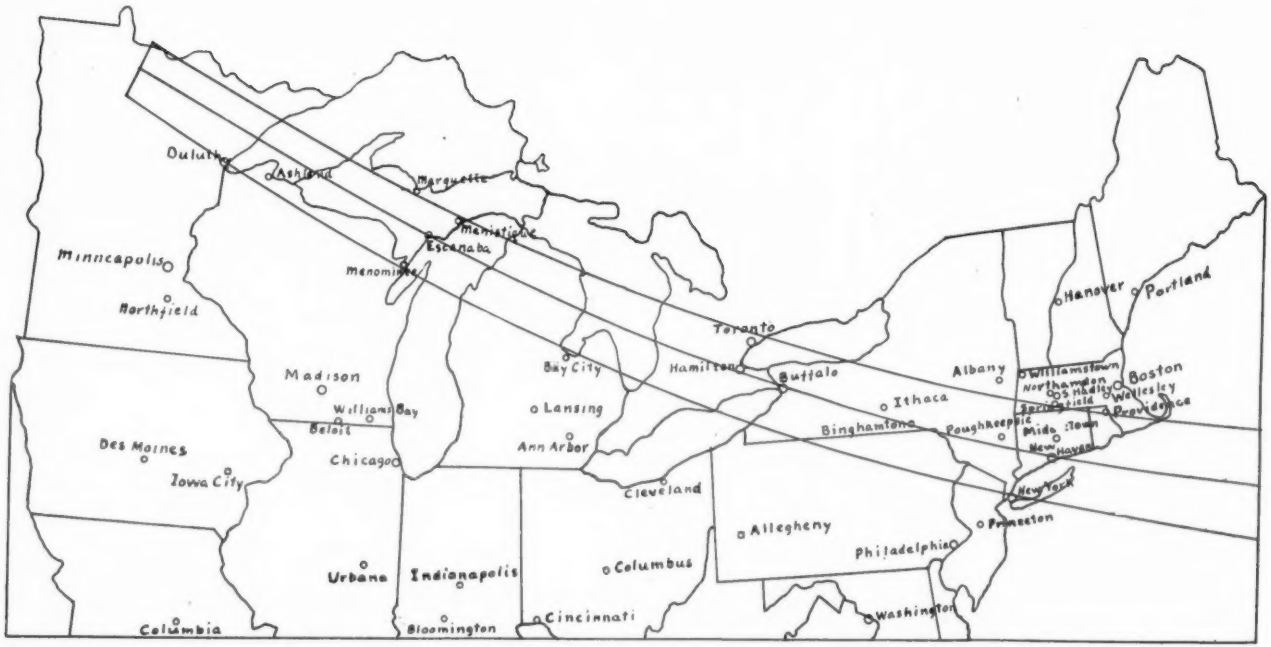


FIG. 2. DIAGRAM OF PATH OF TOTAL SOLAR ECLIPSE 1925, JANUARY 24.

consin and Michigan, the southern part of Canada, the southern part of New York, and almost the whole of Connecticut and Rhode Island. Places close to the central line which are not gvien on that chart are: Two Harbors, Minnesota; Florence, Wisconsin; Crystal Falls, Iron Mountain, Northport, Bellaire, Grayling and Tawas, Michigan; Stratford, Ontario; Warsaw, Geneseo, Danville, Watkins, Elmira, Lanesboro, Newberg and Carmel, New York; and Danbury, Connecticut. Places close to the edge of the path of the moon's shadow very favorable for study of the flash spectrum are Superior, Rhinelander, Crandon and Marinette, Wisconsin; Marquette, Manistique, Menominee, Frankfort, Cadillac, Gladwin and Sandusky, Michigan; Weedsport, Morrisville, Cooperstown and many of the suburbs of New York City, New York; Wellsboro, Laporte, Wilkes-Barre, Newton and Boonville, Pennsylvania; Paterson, New Jersey; Springfield and New Bedford, Massachusetts; and Providence, Rhode Island.

In the early part of December the writer addressed a letter to each of the directors of the observatories in the United States and Canada, asking for information which might be published concerning their plans for observing the eclipse. Nearly all have answered and the replies are given in very nearly their own words in the pages which follow. The account by Professor Edwin B. Frost, Director of the Yerkes Observatory, is so extended and contains so many useful suggestions for both the amateur and professional astronomer, that we have found it best to give it as a separate article immediately following this report.

Allegheny Observatory. Dr. Heber D. Curtis will be associated with the Swarthmore party, located on the campus at New Haven. He is taking along a polar axis, on which he will mount two instruments. The first of these is an infra-red flash spectrograph, utilising a grating 5.2 x 3.1 inches, and of only 34 inches focal length. The second is a prism interferometer, using an etalon of 1 mm separation, for an attempted attack on the green coronal line.

"The eclipse is rather a forlorn hope, at best. Still, no one can tell; we might 'draw' a crystal clear winter morning."

Cincinnati Observatory will send out no expedition but will make such observations as can be made there. If clear the times of contact will be observed and Dr. Smith will take some photographs.

Dominion Astrophysical Observatory has made no preparations for observing the eclipse on account of the uncertain weather conditions, "Though it may probably be fine there and shame the famed California weather which behaved so scandalously."

Dominion Observatory. Director R. Meldrum Stewart writes that the Dominion Observatory will send a small party to a location a few miles south of Hamilton, the same point as that chosen by Professor Chant. Owing to the probability of poor observing conditions the party

will devote itself mainly to magnetic and wireless observations. Magnetic observations will be made for declination and inclination for several hours before and after totality, as well as on preceding and succeeding days, according to the usual eclipse program. The wireless observations will consist of a comparison, for both long and short waves, of the eclipse effects on receiving conditions with those depending on the ordinary daylight-darkness effects. If the weather is favorable, times of contacts will also be observed.

DRAKE UNIVERSITY OBSERVATORY will send no one to observe this eclipse. "As the time draws near that old feeling and desire is certainly strong, and if it were at all possible I would be on the ground with the faithful old telescope, but must forego the pleasure this time."

DUDLEY OBSERVATORY is making no preparations to observe the eclipse. Some of the observers will undoubtedly run down to Poughkeepsie to see the eclipse but will take along no equipment.

DETROIT OBSERVATORY, Ann Arbor, Michigan, will not make any special observations of the eclipse. Some of the observers may go just to witness it.

FUERTES OBSERVATORY, Cornell University, Ithaca, New York. Director Samuel L. Boothroyd writes, "We are preparing to make the following observations at the time of the total eclipse of January 24:

"To get the times of contact. We shall get our own observations for clock correction before and after the eclipse. We may also compare our clocks with the wireless signals from Arlington on the day of the eclipse and on the preceding day.

"To photograph the inner corona with the 12-inch equatorial of this observatory.

"To photograph the outer corona with a lens to be loaned by the Lowell Observatory.

"To photograph the coronal spectrum with a slitless spectrograph to be loaned by the Lowell Observatory.

"We should like also to get the flash spectrum with a concave grating but are not quite sure yet whether we can arrange for this.

"Several persons have volunteered to observe the shadow bands and I hope we shall have several more observers who will do this."

GOODSELL OBSERVATORY will send no formal expedition, but Professor E. A. Fath and a number of students will probably go to Bayfield, Wisconsin, to witness the eclipse and to make such observations as can be made with light portable apparatus. They will attempt to photograph the corona with cameras, to photograph the flash spectrum with the two-prism apparatus used at the eclipse of 1918, to make visual observations of the shadow bands and photograph them if possible.

HARVARD OBSERVATORY will set up four small stations along the eclipse path. One will be in western New York State, one in the vicinity of Poughkeepsie, one at New London, and one at the Maria

Mitchell Observatory on Nantucket Island. Aside from some direct photographs of the corona with small cameras, the program will consist only in photometric surveys of the colors and brightness of the corona, using four identical pinhole cameras of the general design of the instrument taken by Miss Cannon to Catalina Island last year.

LADD OBSERVATORY. A party from Ladd Observatory, Providence, Rhode Island, will be stationed on the grounds of Van Vleck Observatory, Wesleyan University, Middletown, Connecticut, for the eclipse of January 24, 1925. Professor Clinton H. Currier will be in charge of the party. It is planned to observe the times of contact, study the corona both photographically and visually, and study the shadow bands. The flash spectrum will also be photographed.

LEANDER MCCORMICK OBSERVATORY. Director S. A. Mitchell writes, "The Leander McCormick eclipse expedition will be located at the Van Vleck Observatory, Middletown, Connecticut.

"Its main endeavors will be concentrated on the photography of the flash spectrum, my own particular work at five preceding eclipses. Equipment will be practically the same as heretofore used. Concave grating of 10 feet radius, 15,000 lines per inch and 4 inches aperture, the grating loaned by Professor F. A. Saunders of Harvard. This is the same grating with which I secured photographs in 1905. As usual the grating will be used horizontally, the light reflected by coelostat.

"On the 20-inch telescope of the Van Vleck Observatory two spectrographs will be mounted. These have been kindly loaned by the Lick Observatory. Both spectrographs were used by Moore with great success at the eclipse of 1922. One spectrograph will be with slit, the other without. Each will be of one prism dispersion.

"I shall have charge of the concave grating and will be assisted by Professor George B. Pegram, dean of Engineering Schools of Columbia University. The corona spectrographs will be handled on eclipse day by Dr. Harold L. Alden of this Observatory."

LICK OBSERVATORY. Director Robert G. Aitken writes that the Lick Observatory has no plans for observing the eclipse on January 24, 1925. "There are so many observatories directly within the shadow path and so many eastern astronomers are planning for observations, that it did not seem necessary to send an expedition from here."

THE MARIA MITCHELL OBSERVATORY is coöperating with Harvard College Observatory, which is sending a small expedition to Nantucket Island.

MOUNT WILSON OBSERVATORY is planning to send a small expedition to observe the eclipse at Middletown, Connecticut. The observations will consist of photography of the flash spectrum by Dr. Anderson with a large concave grating and measurements of the coronal radiation with a vacuum thermocouple by Dr. Pettit and Dr. Nicholson. Speculum mirrors will be used for the work on the flash spectrum in order to admit of reaching the ultra-violet region.

The apparatus for observing the coronal radiation consists of a 20-inch concave mirror of 40 inches focal length mounted equatorially and driven by clockwork. The thermocouple is placed directly in the focus of this mirror and is connected with a sensitive galvanometer. The plan of observations provides for a series of measurements of the galvanometer deflections for the thermocouple when used without a screen, with a microscope cover glass screen, and with a water cell. This will make it possible to analyze the coronal radiation in three regions of wave-length.

PERKINS OBSERVATORY, Delaware, Ohio. Director Clifford C. Crump, on account of the work at the new observatory and the routine of classes has been unable to make any plans for the eclipse on January 24. He will try to get into the path of totality but it will probably be just to witness the event.

PRINCETON UNIVERSITY OBSERVATORY is not making any official plans to observe the eclipse of January 24. Professor Russell expects to be in New Haven on that date, and hopes to *see* the eclipse, but not to observe it. His colleagues of the department have similar plans.

SPROUL OBSERVATORY. Director John A. Miller writes that "the Swarthmore College Expedition will go to New Haven. Professor Schlesinger has very generously permitted the expedition to erect its instruments on the campus of the Yale University Observatory.

"Our program is as follows:

1. Secure photographs of the corona. For this purpose we shall use a lens 62½ ft. focal length, 9 inches aperture, loaned us generously by the University of Indiana, two lenses 15 ft. focal length, one lens 72 inches focal length, and two lenses of shorter focal length.

2. We shall undertake to obtain a flash spectrum with the same gratings used at the Mexican eclipse. We shall employ two Etalon Interferometers with the hope of obtaining the motion of the coronium of the sun.

3. We shall attempt again the test of the theory proposed by Dr. Charles Lane Poor, namely, that the fall of temperature in the shadow cone will produce refraction of light coming from the sun to account in part for the observed refractions of light coming from the star rays and passing the sun during the time of a total eclipse.

"The personnel of the observing party will include myself, Professor Marriott, Professor Wright, and Professor Pitman of Swarthmore; and Professor H. D. Curtis of Allegheny. Dr. Curtis will include in his program a flash spectrum with a grating particularly constructed to obtain the flash down in the infra-red, also an Etalon Interferometer. He will, using a grating, attempt to obtain the coronal ring. Most of the instruments are now in place, having been erected preceding the coming of the winter. Practically all adjustments have been made except those that, of necessity, must be made not too long before the eclipse occurs."

TORONTO OBSERVATORY. The University of Toronto station, in charge of Professors C. A. Chant and R. K. Young, will be about four miles south of Hamilton, Ont., at an altitude of about 645 feet above sea-level or 400 feet above Lake Ontario. It is intended to photograph the corona with a horizontal camera of aperture 5 inches and focal length 45 feet. The polarization of the corona will be studied by means of a multiple camera having four lenses, each of focal length 42 inches. Crossed nicol prisms are mounted in front of two of the lenses. An attempt will also be made to photograph the "flash" spectrum by means of a transmission grating over a Tessar lens of focal length 36 cm.

U. S. NAVAL OBSERVATORY. Captain Edwin T. Pollock, Superintendent, writes: "The Naval Observatory will have charge of the observations of the total solar eclipse of 24 January, 1925, to be made from the U. S. Navy dirigible, *Los Angeles*.

"The observations as now planned include photographs of the corona with cameras varying from 9 to 48 inches in focal length. Most of the exposures will be short, but experiments will be made with a few longer ones, if practicable.

"There will also be spectrographic observations and moving pictures of the corona, and a trial will be made of photographing the approaching and receding shadow.

"Drawings of the corona will be made, also visual color observations, and observations of the contact times, and of shadow bands.

"A search will be made for comets, planets, etc., and the visibility of the corona outside of totality will be noted.

"The *Los Angeles* will probably be located near the central line, in longitude about 70° west of Greenwich, over the Atlantic Ocean."

VASSAR COLLEGE OBSERVATORY. Miss Caroline E. Furness, director, writes: "At Vassar we are planning to use the 12-inch telescope for photographing the corona. A camera box is being made to take the place of the regular tailpiece, which will be fitted with a color screen and will hold 5 x 7 plates. Seven exposures will be taken, both long and short. Four small telescopes will be used for drawing the corona and one for getting times of contact. There will be three who will observe the flash spectrum and the chromospheric and corona rings with field glasses fitted with replica gratings, or we may use regular Wallace direct vision spectroscopes. Students are being trained to draw the corona, to observe the shadow bands, to count time, to draw partially eclipsed sun, etc. Astronomers from Smith, Swarthmore and Yerkes will be at Vassar.

"A special emphasis is being laid upon the educational aspect of the eclipse. Lectures have been given in the schools of Poughkeepsie, and to other audiences. A series of articles is appearing in the county paper.

"The Western Electric Company is providing loud speaking telephones to count the time during totality."

VAN VLECK OBSERVATORY. Director Slocum writes: "We are planning to use during the eclipse the 20-inch visual refractor, 28 feet focus, a 4-inch visual lens, 26 feet focus, a 3-inch photographic lens, 11 feet focus, a 6-inch visual refractor, 6 feet focus, several cameras from 6 to 1 inch aperture, two or more small spectrographs.

"With the 20-inch we shall try for the prominences and inner corona using color filter and Iso plates. After totality this instrument will be used to photograph the partial phase for the relative position of the sun and moon. With the other telescopes and cameras we shall make short and long exposures on the corona in blue, yellow and red light. We shall try for the flash spectrum on a small scale and may attempt to photograph the shadow bands.

"Five expeditions have thus far definitely decided to locate here: Mt. Wilson under Anderson, Virginia under Mitchell, Wisconsin under Stebbins, Harvard Laboratory under Stetson, and Brown University under Currier. Three or four other parties will probably join us. Mr. Wagman of Pittsburgh says that east of Michigan the skies will be clear on Jan. 24. I hope his prediction comes true, but I fear he is a Wag Man."

WHITIN OBSERVATORY. It is planned that a party of Wellesley students and faculty members will go near the central line of the eclipse, probably to New Haven or New London, to make visual observations with the naked eye and with small telescopes. More definite plans have not yet been formulated.

YALE OBSERVATORY. The plans of the Yale University Observatory include observation by photography of the partial phases at definite instants of time for determination of the moon's position, time determinations of the second and third contacts, photographs of the moon during totality for the measurement of its diameter with the corona as a background and photographs with different exposures to determine the shape and extent of the corona.

The time and position determinations are made in connection with a general campaign which is to be carried out by observatories all over the world during two months, one preceding and one following the eclipse. This campaign is directed towards a determination of the observed path of the moon during this period so that it may be compared with gravitational theory. The long-period differences are fairly well known: differences of short period require more observational material for their proper study.

The photographic work will be mainly carried out with the Loomis telescope and the catalogue camera, which will be temporarily diverted from their regular programs for this purpose. The possession by the observatory of some highly accurate and sensitive thermometers has suggested their use for the determination of changes of temperature

during the eclipse. In the expected absence of the director, the observational program has been placed in charge of Mr. Stearns.

The observatory also expects to have two or three expeditions from elsewhere located on its grounds. The erection of buildings for observations by Swarthmore and Allegheny has already been completed.

YERKES OBSERVATORY. See following article.

TENTATIVE PLANS FOR THE OBSERVATION OF THE TOTAL ECLIPSE BY MEMBERS OF THE STAFF OF YERKES OBSERVATORY.

By EDWIN B. FROST.

It is already known that there will be a large concentration of astronomers from various institutions at the observatories fortunate enough to lie in the track of the eclipse, and having the best chances of clear sky according to such statistics of the weather as are available. We know by sad experience that the "signs fail" too often on such occasions. It therefore seems to be sound policy to provide for the contingency that the western portion of the track might be clear, while the eastern portion might be cloudy. Accordingly, if the authorities of the University of Chicago find the necessary funds, it is proposed that the Yerkes Observatory shall carry out a small program at a point slightly north of the Wisconsin and Michigan State Line, in the vicinity of Iron Mountain, Michigan. Owing to the wintry conditions which will almost certainly prevail, it will be impossible to set up heavy coelostats or equipment requiring special housing. It is probable that Professors Frank E. Ross and Oliver J. Lee will take to the point selected the upper part of the small equatorial mounting used for our Sky Patrol.

So far as at present decided upon, their program will include the photography of the corona, with kryptocyanine plates, sensitive to wave-lengths at λ 7600A, with the Zeiss apochromatic planar lens of aperture 51 mm and 315 mm focus; and with the Tessar of aperture 66 mm and focal length 308 mm, using an Eastman's Wratten mercury green filter No. 62 and plates sensitive to the wave-length near the principal visual coronal radiation at λ 5303. These two lenses are the ones now in use on the Sky Patrol.

A new lens, designed by Professor Ross, of aperture 3 inches and focal length 21 inches, having a wide field and promising some improvements over the astronomical objectives already designed by Dr. Ross, is in process of construction by Mr. C. A. Robert Lundin of the Alvan Clark & Sons Company. It is expected that this lens will be ready for the eclipse, for a photograph of the whole region within 10°

of the sun, with the use of ordinary plates sensitive to the violet.

The Clark doublet, of 3.4 inches aperture and 20 inches focal length, long used by Professor Barnard, may perhaps also be employed.

We are at present seeking to borrow a quartz lens of about 50 mm aperture and 25 to 30 cm focal length, for the photography of the corona with ultra-violet rays (offers from kind friends will be very acceptable). Not much definition can be expected from such a lens, and if we fail to obtain a suitable one we may use the achromatic fluorite-quartz-flourite lens of 2 cm aperture and 8 cm focal length, which forms a part of the small spectrograph used with the 24-inch reflector. Owing to the small size of the image, lantern slide plates would have to be used with such lenses.

Messrs. Ross and Lee are proposing to photograph the shadow bands according to plans on which they are working, involving an exposure at least ten times that usually attempted for shadow bands. The little "gun-sight" camera, which was intended for use at Catalina, and having the unusual ratio 1 : 1½, will be available, among others, for this purpose.

It is not expected that the expedition will be at the observing station for more than three days. A suitable site will probably be found in connection with some High School in the vicinity selected. It is possible that a cinema camera will be used at this station by some experienced photographer.

Dr. Frank D. Urie will be sent by the Elgin National Watch Company to accompany the party and will care for the reception of the time signals by radio, and will also make determinations of contacts.

Clouds at the eclipses of 1918 and 1923 prevented Professor Parkhurst from securing the visual observations of the intensity of the coronal radiation with the Hartmann surface microphotometer, mounted as an altitude and azimuth instrument. It therefore seems desirable that he should again attempt the observation, which would be independent of the unsteadiness which may be expected at the low altitude of the sun characteristic of this eclipse at all stations on land. If funds are provided, Mr. Parkhurst will probably set up his apparatus at some station in the state of New York, apart from the concentration of astronomers referred to above. Because winter mornings, particularly if the weather should happen to be mild, are very freakish in respect to clearness of the sky, it therefore seems highly desirable that as many scattered stations should be occupied as possible.

We expect to be very busy on that morning at the Yerkes Observatory, if the weather favors us. The writer called attention in POPULAR ASTRONOMY, Volume 26, pp. 297-299, 1918, to the remarkable opportunity which a nearly total solar eclipse offers for spectroscopic observations at points outside the track of totality. At the eclipse of April 17, 1912, which had a maximum phase of 92 and 90 per cent at London and Cambridge, Professors Fowler and Newall were able to

secure some surprisingly fine conditions of observing the lower chromosphere and even the reversing layer. Their observations were published in some detail in the *Monthly Notices,* Volume 72, pp. 536-538, 538-541, 1911-1912, to which readers are again referred. It is not known to the writer that similar conditions have been utilized at later eclipses by physicists at fixed laboratories where high dispersion can be used. At the present eclipse, all of the leading physical laboratories in the United States east of Wisconsin and north of latitude 41° in Illinois, or about 37° at the Atlantic Coast, will enjoy a maximum phase of 90 per cent or more. For the many institutions where the phase will be 95 per cent and more, the opportunities will be far better for spectroscopic observations than they could be within the zone of totality itself. Under the latter circumstances, hardly more than two seconds would be available at each contact, while from points off the track, as above, reversed lines should be visible for well over half an hour, or perhaps an hour, and exposures of ten seconds could be attempted in regions of the spectrum where the sensitiveness of the plates is low.

We shall expect to use the 40-inch telescope with either the Rumford spectroheliograph or the Bruce spectrograph equipped with three prisms; the 12-inch, with the solar spectrograph attached thereto; the U.-V. camera, covered with the 30° and 15° U.-V. prisms, to yield an objective-prism spectrum; and probably we shall mount on the reflector a small concave grating for the direct photography of the infra-red flash spectrum with kryptocyanine plates and the appropriate filter. With the Bruce photographic telescope we may secure direct photographs as records of the event.

The fact that hardly more than one-fifth of one per cent of the full light of the sun will be left at the time of maximum phase in the populous regions of the Middle West will doubtless make this eclipse of much public interest, if the weather should be favorable. No eclipse so nearly total has occurred in the vicinity of Chicago since Aug. 7, 1869.

Williams Bay, Wisconsin, Yerkes Observatory,
December 15, 1924.

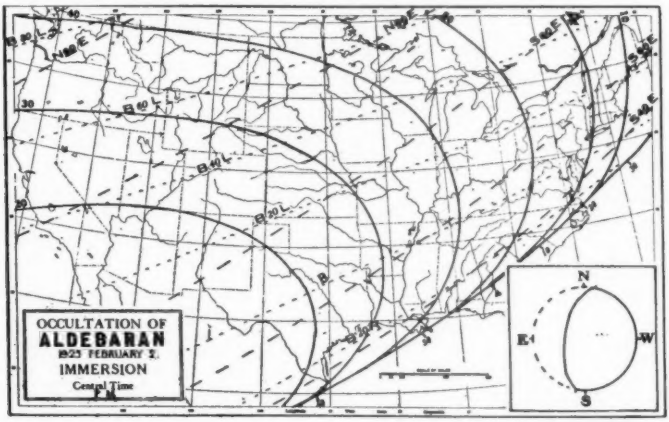
OCCULTATION OF ALDEBARAN 1925 FEBRUARY 2.

By WILLIAM F. RIGGE.

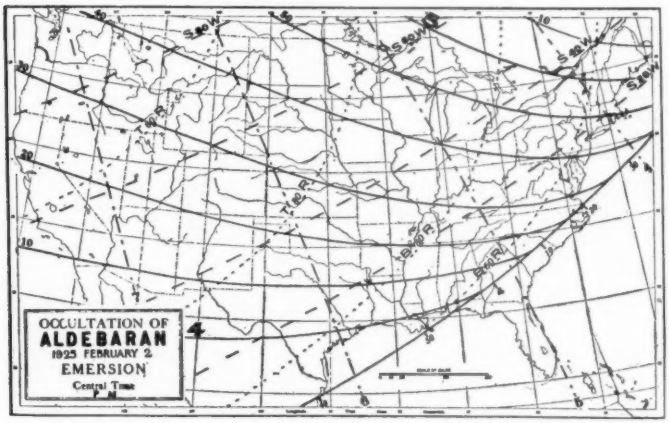
The occultation of Aldebaran of February 2 is the only occultation of a bright object during the present year, and also the last one of Aldebaran for 16 years to come. With it our shower of occultations comes to an abrupt end.

While our eastern friends will enjoy a good view of it after sunset, our western ones must be content with a daylight occultation. On the

accompanying maps the full lines give the times at intervals of ten minutes, the large 4 and 5 meaning 4 and 5 P. M. Central Time. The



dashed lines give the position angles from the cardinal points N.S.E.W. and the dotted ones those from T.B.L.R. (top, bottom, left, right). The numbers on the limit line denote the times of the grazing contacts.



The dot-and-dash lines marked 4, 5, 6, 7, give the central times of sunset. The moon is 9.3 days old. Its appearance is shown in the insert in Fig. 1. The north end of the terminator is in position angle N 11° 19′ W.

THE OBSERVATION OF OCCULTATIONS IN JANUARY AND FEBRUARY 1925. (Second Paper).

By L. J. COMRIE.

This paper gives predictions supplementing those in POPULAR ASTRONOMY for December, 1924. Prof. E. W. Brown has announced that sufficient coöperation has been promised to secure the reduction of all occultations observed during the month preceding and the month following the eclipse of January 24, and their comparison with the Tables. It is to be hoped that every effort will be made to secure all possible observations during this short trial period.

Observations near the time of the eclipse are specially important, so a table is given with Besselian elements of a number of stars not in the *A. E.* list. Predictions for these stars are given for four stations only—Swarthmore, Evanston, Denver and Lick—for which special tables were available. On January 27 and for a few days following, observers are asked to sweep the region east of the moon and observe immersions of any stars brighter than $9^{M}.0$. It has not been found possible to give further predictions for Harvard and Cincinnati. The predictions for Albany, N. Y., have been made by Mr. J. E. G. Yalden.

BESSELIAN ELEMENTS.

The Stars			At Conjunction in R. A.				
Name	Mag.	App. Dec. —	G. C. T. Jan.	H +	Y +	x' +	y'
		° ′	d h m	h m			
Pi $16^{h}305$	6.9	19 20.4	21 11 39.0	2 34.5	0.9030	0.6046	—0.0878
166 B Ophiuchi	6.6	19 15.2	21 15 39.2	6 25.0	0.4814	0.6070	—0.0793
17 Sagittarii	7.1	20 34.1	22 12 55.6	2 49.4	0.6051	0.6159	—0.0300
B. D. —20°5516	6.9	20 47.0	23 13 36.3	2 27.6	0.8274	0.6184	+0.0312
W. B. $21^{h}1071$	7.8	14 32.7	25 23 59.1	10 28.9	0.2906	0.5908	+0.1514
B. D. —11°5933	8.4	10 48.4	26 23 54.7	9 31.6	0.5360	0.5736	+0.1798
243 B Aquarii	6.7	10 37.6	27 1 3.6	10 38.0	0.3935	0.5726	+0.1809

NOTES.

Jan. 21 Pi $16^{h}305$. Can be favorably observed in eastern and southeastern states.
166 B Ophiuchi. Visible in Pacific states. At Lick emersion occurs 14^{m} before sunrise.

22 17 Sagittarii. Can be best observed from places about 6^{h} west. In eastern states sunrise occurs before emersion. Below horizon for western states.

23 B. D. —20°5516 Moon's age $-1^{d}.1$. Observations will be extremely difficult but valuable if made. Immersion may be seen in eastern states a few minutes after moonrise and a few minutes before sunrise. Emersion observable from places having about same longitude as Chicago.

25 W. B. $21^{h}1071$. Moon's age $1^{d}.4$. Immersion visible in neighborhood of Denver.

26 B. D. —11°5933. Moon too low in extreme eastern states. Immersion visible after sunset in central states as far west as Denver.
243 B Aquarii. Visible under favorable circumstances in western states.

Date	——The Star's—— Name	Mag.	Immersion Time	P. A.	Emersion Time	P. A.
		ALBANY, N. Y.	Eastern Time.			
			h m	°	h m	°
Jan. 12	227 B Cancri	6.4	5 27	50	6 4	346
22	15 Sagittarii	5.3	5 56	109	7 0	269
26	70 Aquarii	6.1	18 57	87	Below horizon	
29	117 G Piscium	6.5	20 53	58	21 56	258
Feb. 2	Aldebaran	1.1	16 58	117	17 43	224
4	119 Tauri	4.9	21 51	138	22 43	211
8	ψ Leonis	5.6	20 24	123	21 35	262
15	13 Librae	5.7	3 50	119	5 9	292
16	190 B Librae	6.5	Below horizon		1 41	279
		SWARTHMORE, PA.	Eastern Time.			
Jan. 12	227 B Cancri	6.4	5 25	62	6 11	329
21	Pi 16^h305	6.9	5 28	161	6 6	232
22	15 Sagittarii	5.3	5 54	117	6 55	262
22	16 Sagittarii	5.9	6 4	35	6 31	345
22	17 Sagittarii	7.1	6 32	67	7 27	312
23	B. D. —20°5516	6.9	7 4	101	Daylight	
26	70 Aquarii	6.1	18 51	93	19 51	222
29	119 G Piscium	6.5	20 54	69	21 58	248
Feb. 2	Aldebaran	1.1	16 56	126	17 42	194
3	119 Tauri	4.9	22 0	154	22 30	192
6	10 H Cancri	6.1	21 50	25	22 16	350
8	ψ Leonis	5.6	20 25	135	21 29	250
15	13 Librae	5.7	3 49	128	5 7	284
16	190 B Librae	6.5	Below horizon		1 37	267
		EVANSTON, ILL.	Central Time.			
Jan. 21	Pi 16^h305	6.9	4 31	180	4 49	212
22	17 Sagittarii	7.1	Too low		6 17	298
23	B. D. —20°5516	6.9	Below horizon		7 0	259
26	B. D. —11°5933	8.4	18 38	80	Too low	
		DENVER, COL.	Mountain Time.			
Jan. 25	W. B. 21^h1071	7.8	17 59	25	Below horizon	
26	70 Aquarii	6.1	Daylight		17 13	268
26	B. D. —11°5933	8.4	17 25	69	18 30	242
26	243 B Aquarii	6.7	18 53	59	Too low	
		LICK OBSERVATORY.	Pacific Time.			
Jan. 21	166 B Ophiuchi	6.6	6 23	51	7 4	340
26	243 B Aquarii	6.7	17 44	49	18 46	261

Dearborn Observatory, Evanston, Ill., 1924 Dec. 21.

NOVAE.

Blazing suddenly in the sky,
A flaming sun is born on high!
Now brighter growing, night by night,
O what an awe-inspiring sight!
In dark abysmal depths of space,
A brilliant nova we can trace;
Colliding with a cosmic cloud,
An orb is with new life endowed;
Behold! a new world launched in space,
A stellar miracle taking place!

Hagerstown, Md., Sept. 5, 1924. LESLIE C. BEARD.

AMERICAN ASTRONOMICAL SOCIETY.

REPORTS OF OBSERVATORIES
1923-1924

The reports which follow are arranged alphabetically according to the names of the observatories or of the institutions with which they are connected. Unless otherwise noted, each report covers the twelve months ending June 30, 1924.

ALLEGHENY OBSERVATORY
UNIVERSITY OF PITTSBURGH
PITTSBURGH, PENNSYLVANIA

There have been no changes in personnel during the year.

During this year 2,239 plates have been taken with the Thaw photographic refractor, bringing the total for this instrument up to 32,921 plates. Satisfactory progress has been made in Mr. Jordan's extensive photometric program, and in the parallax program, the latter in charge of Mr. Daniel. Present parallax determinatons, of which about 140 are awaiting publication, are made to depend upon at least twenty plates, each with three images, of quality "O K", or better, and with a minimum of seven observing epochs; the mean probable error of the unpublished material on hand is 0″.006, and it is hoped eventually to bring this quantity down to 0″.005 in future determinations. The observational portion of the parallax program has far outstripped available facilities for measurement and reduction. If two or three additional measurers and computers could be employed, it is estimated that material is on hand for the determinations of about six hundred additional parallaxes in the next three years.

Excellent progress has been made by Mr. Burns in the program of precise solar wave-length determination by the interferometer-grating method, which is being carried on in coöperation between the Allegheny Observatory and the Bureau of Standards. Two hundred and ten plates have been secured on the sun with vacuum arc comparison, with interference orders ranging from 15,000 to 50,000. The region 4000 to 4700 A is about three-quarters completed, and the regions 3800-4000 A and 4700-7200 A are about one-quarter completed; these figures apply only to the photographic portion of the program, though good progress is being made in the larger task of measurement. As a by-product of this extensive program, in which an accuracy of one

part in five million is easily secured, Mr. Burns has obtained data as to the shift of the solar lines to the red which appear to negative the prediction made from the theory of relativity. Einstein predicted a shift of the solar lines to the red amounting to .009 A, the same for all lines in any given spectral region. Burns finds a regular progression in shift to the red, varying with the line intensity; the finest and sharpest lines of intensity 0-1 are shifted little, if at all, to the red, and the plotted shifts fall on a regular curve as stronger lines are used until a shift of about 0.016 A is found for lines of intensity 10-15. As these values are secured from the integrated light of the complete solar disk, and the general form of the intensity-shift curve is secured also at the sun's limb, it seems impossible to reconcile this progressive shift with the simple Einstein prediction through any considerations of high or low levels, or any velocity factors depending upon ascending or descending currents.

Considerable auxiliary apparatus has been constructed by Mr. Curtis for the solar work and for other researches. These include a vacuum arc (described in *Journal of the Optical Society of America*, **8**, 697), electrical slow motions for the coelostat attached to the Keeler reflector, a new, massive, micrometer screw for the engine on which the solar plates are measured, etc. An interferometer of special design has also been built, following the Zehnder-Mach type; each element of this instrument weighs over a hundred pounds; the rather massive construction secures a very permanent fringe system with optical paths of five meters.

In the Frick Public Evening Service 4,822 visitors were entertained during the year by Mr. W. R. Ludewig at the 13-inch telescope or in the Observatory's lecture room. Mr. Ludewig's "total" in this appreciated service is now in excess of one hundred thousand.

HEBER D. CURTIS, *Director.*

STUDENTS' OBSERVATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

As heretofore, instruction of a large body of students has been the chief activity of the Berkeley Astronomical Department.

The upper division course in astrophysics, in charge of Mr. Meyer, has been further developed with the coöperation of the astronomers of the Lick Observatory, so that it should afford an excellent preparation for students majoring for higher degrees in astrophysics at the Lick Observatory.

R. T. Crawford, professor of astronomy, and W. F. Meyer, associate professor of astrophysics, have completed a very laborious investigation of the possible identity of Comet *b* 1922 (Skjellerup) and Comet *c* 1902 (Grigg). Owing to a very close approach of the former comet

to Jupiter in 1905, which required the calculation of special perturbations at one day intervals for several months, its orbit was radically changed. Before definite conclusions on the question of identity can be reached, it will be necessary to have a better set of osculating elements, especially a better mean motion, based upon observations of the 1922 and 1927 apparitions.

S. Einarsson, associate professor of practical astronomy, has constructed a table of azimuths of the sun for the latitude of Fairfax, Marin County, the new site of the Summer School of Surveying of the University. With the aid of his students in navigation, he has also set up a table of altitudes of celestial bodies at Berkeley, by interpolation from Table 201 of the Hydrographic Office, U. S. N. (Line of Position). Errors were found in the government tables which have been communicated to the Hydrographic Office. The purpose of these tables is that of checking student observations and computations.

W. F. Meyer, associate professor of astrophysics, has tested a new apparatus, which he and Mr. J. A. Pearce, fellow at the Lick Observatory, intended to use for polarigraphic observations during the total solar eclipse on September 10, 1923, in affiliation with the Lick Observatory eclipse party at Ensenada, Mexico. No observations were secured of the eclipse on account of unfavorable weather.

C. D. Shane, assistant professor of mathematics and astronomy, has been engaged during the year in experimental work preparatory to applying interferometer methods to astronomical spectroscopy. Modifications of existing laboratory methods have been devised, tested, and found to be applicable to small sources of light, such as are found in most astronomical objects. A spectroscope has been designed and constructed under his direction, with the purpose of applying it to the study of the nebulae. It is to be used on the Crossley reflector at the Lick Observatory during the first half of the Academic year 1924-25.

A system of exchanges between members of the Lick and Berkeley astronomical departments has been inaugurated for the academic year 1924-25. Assistant Professor Shane will reside at the Lick Observatory and Astronomer J. H. Moore will offer instruction at Berkeley, including a graduate course in astrophysics.

A. O. Leuschner, professor of astronomy, assisted by H. Thiele, research associate in astronomy, has continued his investigations of the perturbations of minor planets, with the aid of grants received from the Carnegie Institution at Washington, and from the National Academy of Sciences.

The department has continued to coöperate with various observatories in providing orbits with ephemerides, particularly for small planets lost soon after discovery. One of the most interesting cases of this sort was the recent rediscovery of minor planet Y. O. 11, on the basis of computations by Mr. A. D. Maxwell, a graduate student in astronomy, and Mr. Thiele. This planet moves in an orbit similar to

that of Themis, and in close proximity to it. If Y. O. 11 is re-observed in the next opposition, it should be possible to derive an orbit sufficiently accurate to determine whether or not its motion may be disturbed by Themis.

A. O. LEUSCHNER, *Director.*

OBSERVATORIO NACIONAL ARGENTINO

CÓRDOBA, ARGENTINA

(Year ending December 31, 1923)

Notwithstanding the continued unfavorable weather conditions, the southern observations required for the fundamental catalog at the present epoch were obtained, 3845 observations on 109 evenings and 85 mornings. It is planned to send the meridian circle and the same observers to the northern hemisphere to observe the corresponding stars for the northern sky. Investigation of the annual term in the right ascensions was continued, chiefly in the direction of finding some method of observing transits which would eliminate all question of personality.

The observations for the combination catalog (DM and AG zone), —82° to the pole, have been completed and the reductions are well under way. The observations to complete the remaining zone of the Córdoba DM —62° to —82° were commenced, 4412 stars being observed. These were chiefly in —62°, the overlapping degree which is required in the preparation of the maps —42° to —62°. Work on the maps is being commenced.

179 plates for the Astrographic Chart were obtained, of which 155 are suitable for engraving. This leaves 39 regions to be photographed to complete the Córdoba zone. The engraving of the charts is well under way. The 180 plates of the first zone, —25°, are completed and printing will commence early in 1924.

The measures for the zone —24° of the Astrographic Catalog are ready for the printer. The printing of this volume has been authorized and is expected to begin early in 1924. The preparations of the measures of zones —25° and —26° are well under way. The reductions of the repére stars are practically completed.

Resumption of work on the dome for the 60-inch reflector awaits the provision of funds which lapsed because of the war. It is expected that these will be provided in 1924.

The work of replacing the old administration building with a new, modern, larger and more efficient structure began early in December.

C. D. PERRINE, *Director.*

DEARBORN OBSERVATORY
NORTHWESTERN UNIVERSITY
EVANSTON, ILLINOIS

There has been no change in the program of the Dearborn Observatory. As in previous years, it has been directed along two principal lines: photographic observations for stellar parallaxes and micrometric observations, principally of double stars.

The year, June 30, 1923, to June 30, 1924, gave a large excess of cloudy weather. Only 310 plates were secured for parallax determination, bringing the total at the latter date to 5980. Miss Hill continued to devote the greater part of her time to measurement of these plates. A considerable number of unpublished parallaxes are at hand. These are being arranged for publication in the *Annals of the Dearborn Observatory*.

On the double-star program Wylie made about 500 observations and Fox 850. The Fox measures of double stars which have been made since the appearance of Volume I of the *Annals of the Dearborn Observatory* are now being compiled and will appear as Volume II.

The principal changes in the Dearborn Observatory since the last report are in the staff, although these changes have occurred subsequent to June 30, 1924. Mr. Wylie accepted an appointment at Perkins Observatory of Ohio Wesleyan University, effective September 1, 1924, and Miss Hill went to Vassar College as instructor in astronomy. Dr. L. J. Comrie, astronomer, and Miss Vera M. Gushee, instructor, replace them.

Members of the staff continue to give instruction in astronomy to students of the College and Graduate School. With the coming of Mr. Comrie, the number and variety of courses are being increased.

PHILIP FOX, *Director.*

DOMINION OBSERVATORY
OTTAWA, ONTARIO

Changes in staff. Dr. Otto Klotz, formerly director, who died in December, 1923, was succeeded by R. Meldrum Stewart, formerly assistant director. C. R. Westland was added to the staff in the Solar Physics Division.

Meridian Work and Time Service. The present meridian circle programme, recently begun, comprises all Bachlund-Hough stars north of —30° declination and all Boss fundamental stars in the same region, together with some additional fundamental and azimuth stars, including in all some 1,600. Observations of the sun, moon and planets are obtained whenever possible. Daylight observations of fundamental and azimuth stars are also made.

The time service in the government buildings has been maintained and somewhat extended. Wireless time signals from Annapolis and Lafayette have been observed throughout the year, and latterly also time signals from Nauen. A special series of signals from Honolulu for Australian longitude work was observed over several months. Time signals from the Observatory have since March been broadcasted twice a week at 9 P. M. from the Canadian National Railway broadcasting station.

Solar Physics. Observations of the spectra of limbs, centre and midway points of the solar disc were continued, with spectra of iodine absorption, standard electric arcs and arcs in a partial vacuum; improved apparatus has been planned for the vacuum arcs and for the control of their pressure. The year was like the preceding one in being abnormally cloudy and hazy, and the number of observations was again decidedly below the average. Measurements of earlier plates were continued for the group of six lines at λ 5590. Remeasurements of the arbitrarily blended spectra of limb and centre for this group of lines support the earlier conclusions regarding the differential effect for lines of different intensities.

Astrophysics. The 15-inch equatorial has been used in the determination of the radial velocities of stars of the β Canis Majoris, Cepheid and pseudo-Cepheid types. Among those specially studied were ν Eridani, β Cephei, σ Scorpii, δ Cephei, ζ Geminorum; σ Scorpii besides being a short-period variable of the Cepheid type, has also proved to be a physical triple system.

A small equatorial mounting is being rebuilt to support three photographic cameras of 2-inch aperture and 13-inch focal length. These cameras can be independently pointed in any direction and are to be used for obtaining photographic light-curves of the stars under spectroscopic investigation; one camera is already in use. A photoelectric photometer has been ordered and will be used with the 15-inch equatorial to obtain light-curves of the same stars.

Seismology. During the year 298 earthquakes were registered and have been reported by monthly bulletin as usual. Two experimental seismograph stations were occupied for some little time in the summer of 1923 for the purpose of comparison of simultaneous records by similar instruments in different locations. One station was about eight miles west of Ottawa, the other about thirty-five miles to the south. The earthquake records were almost exact counterparts of those at Ottawa, but it was found impossible to identify microseisms at this distance.

Terrestrial Magnetism. During the season of 1923 the three magnetic elements were determined at forty-seven localities, divided between northern Manitoba and the Mackenzie basin. During the season of 1924 observations are being carred on along the western coast of British Columbia and in Yukon Territory.

Gravity. No field observations were made in 1923. In 1924 a series of stations is being occupied in Saskatchewan, Alberta and British Columbia, at points where topographical maps are available.

Publications. Four publications were issued during the year and several others are in press.

R. MELDRUM STEWART, *Director.*

DOMINION ASTROPHYSICAL OBSERVATORY
VICTORIA, BRITISH COLUMBIA

Staff. The staff of the observatory remains as in the preceding year. In addition Mr. W. H. Christie assisted in the observing and measuring during the college vacation term, and Mr. S. N. Hill was assistant computer for the last six months of the period.

Observing. The observing weather for the year under consideration was somewhat below the average, the dome being opened and plates secured on 203 nights. On 72 of these nights the seeing conditions were very poor or clouds interfered to such an extent that a total of only 153 spectra were obtained. On the remaining 131 nights 933 spectra were obtained, but it should be remembered that on about 25 of these nights long exposures were made on nebulae or faint stars, resulting only in about the same number of spectra.

Programs and Results. Practically the whole time of the telescope, except two hours every Sunday night, when it is placed at the disposal of the public for observations of celestial objects of popular interest, has been devoted to photographing stellar and nebular spectra.

The work of the director was signalized by the completion of an investigation of the O-type stars published as Vol. II, No. 16, which had been three years in progress. The principal results are the great masses, average 50 times the sun, high luminosities, average —4 mag., and small mean parallaxes of one thousandth of a second of arc of this remarkable group, definitely placing them at the apex of the evolutionary sequence. Auxiliary results were strong evidence for the existence of widely extended and very tenuous clouds of calcium and sodium vapour throughout space and the arrangement of the Wolf Rayet stars in order of excitation. One O-type binary orbit, 56°2617, was also completed during the year and numerous tests of camera objectives for spectrographs, finally resulting in flat field fine definition lenses, one of f3 for low dispersion and a Ross type for three-prism work.

Messrs. Harper and Young have completed the observations necessary for the absolute magnitude program upon which they have for some time been engaged and the results are published in Volume III, No. 1, which is almost through the press. The parallaxes of 1105 stars of types mostly from F to M, but including also some of A-type, were

thus obtained by the spectroscopic method. Both observers have also obtained spectra of a number of spectroscopic binaries which they have had under investigation, Mr. Young completing two binary orbits and Mr. Harper four. In addition, spectra have been made by Mr. Harper of A-type stars with known trigonometric parallaxes for spectroscopic parallax work.

Mr. H. H. Plaskett has obtained spectra of planetary nuclei and a large number of the nebular envelope star Z Andromedae. He has also secured wedge spectra of the Orion nebula and N. G. C. 7027 and has done considerable experimental work in obtaining interferometer observations of the Orion nebula. The measurement and reduction of the corresponding plates was well advanced during this period.

Mr. Christie has been engaged upon a number of stars selected from the general program of H. R. stars and has published radial velocities for 14 such stars.

Publications. There have appeared during the year as *Publications of the Dominion Astrophysical Observatory,* Volume II, numbers 10 to 16 inclusive, while the first four numbers of Volume III are in press.

Office Building. The contract for a new office building was let in October, 1923, and has just recently (October, 1924) been occupied by the staff. Besides a large library it contains photographic and dark rooms and separate offices for the members of the staff and will be of great convenience in the carrying on of the work.

J. S. PLASKETT, *Director.*

DUDLEY OBSERVATORY
ALBANY, NEW YORK

Reductions of Observations. As in past years the efforts of the major part of the staff have been devoted to the reduction of the San Luis and Albany meridian observations. The San Luis reductions were completed and the results put into manuscript during the year. Satisfactory progress was made in the reductions of the Albany observations and a beginning has been made toward collecting them in catalogue form.

Stellar Parallax. Boss has continued his investigations of the systematic errors of both the trigonometric and spectroscopic parallaxes. For the principal series of trigonometric parallaxes the indicated corrections seem to decrease with the accumulation of material and are, therefore, probably fictitious.

Proper Motions. Wilson has made a study of the proper motions and, through them, of the mean distance and luminosities of the Class-O stars. He finds a considerable range in luminosity, in contrast to what should be expected on the giant-dwarf theory of stellar evolution, but in harmony with Eddington's theory that absolute magnitude is a direct function of mass.

From a comparison of the magnitudes of the Class-O stars in the Large Magellanic Cloud with his deduced absolute magnitudes of the galactic Class-O stars, Wilson estimates the parallax of the Cloud to be 0″.000066, representing a distance of 15,000 parsecs, or about 50,000 light-years.

Raymond and Wilson have continued the investigations of the systematic errors of the Boss proper motions in declination, this year with a homogeneous list of 2962 stars for which both Boss proper motions and radial velocities are available. They have shown that, whereas Kapteyn suggested a correction to the proper motions to account for a difference of 10° between the proper-motion and radial-velocity declinations of the apex of solar motion, solutions based on homogeneous data reduce this difference to but 3°. If this difference be wholly due to systematic errors in the proper motions, a correction of $+''.0042 \cos \delta$ would be indicated, but it is possible that the difference may be due, at least in part, to the skew distribution of the motions of the high-velocity stars not eliminated from the proper-motion solutions by the methods of rejection.

Astronomical Journal. The publication of Volume 35 of the *Astronomical Journal* was completed during the year.

BENJAMIN BOSS, *Director.*

GOODSELL OBSERVATORY
CARLETON COLLEGE
NORTHFIELD, MINNESOTA

There have been no changes in the staff this year and the work has been carried on along the same lines as last year.

The observers have had nearly full time in teaching mathematics and astronomy and editorial work on the magazine *Popular Astronomy.*

Mr. Fath has met with unexpected difficulties in the operation of the new photo-electrometer, to be used with the 16-inch refractor, but hopes to soon overcome these and begin regular work with the apparatus.

Messrs. Wilson and Gingrich have continued the series of photographs of asteroids brighter than magnitude 12. About 30 measurable photographs were obtained during the year covered by this report, the number being less than usual because of the dismounting of the photographic telescope, to be used in observing the total eclipse of the sun on September 10, 1923. The measurement and reduction of these photographs is well advanced.

The number of photographs taken could be greatly increased, if we had the means to employ skilled measurers and computers to get out the results quickly.

Miss Anne S. Young, director of the Mount Holyoke Observatory

has continued her coöperation in the measurement and reduction of the asteroid photographs.

Publication No. 10 of the Observatory was issued during May, 1924, containing the measures of 105 plates with resulting positions of 58 asteroids.

Time signals have been sent out daily by wire to the Great Northern, Northern Pacific, and the Milwaukee, St. Paul and Sault Ste. Marie railroads.

HERBERT C. WILSON, *Director.*

HARVARD COLLEGE OBSERVATORY
CAMBRIDGE, MASSACHUSETTS

The protection of the Harvard photographic collection against fire, the completion of the Henry Draper Catalogue, the expedition to northern Chile, the progress of researches on the chemistry of the stars, the initiation of an extensive investigation of the structure of the Milky Way, and the derivation of the distances of the Magellanic Clouds constitute six major factors in the past year's work at the Observatory.

1. *Fireproofing Building C.* Since the first photograph of a star was made at Harvard in 1850 under the supervision of Professor George C. Bond, the Observatory has been a repository for an ever-growing collection of astronomical photographs. The systematic photographic work with several telescopes was begun prior to 1900. Dozens of telescopes at the Observatory stations in Cambridge, Arequipa, and elsewhere have added to this collection. Some three hundred thousand plates are stored in Building C, nearly all of which are of value in current problems. The photographs made before 1900 are especially serviceable in the study of stellar motions and variability, and they are, of course, irreplaceable, and are unduplicated at other observatories.

The storehouse for these plates, Building C, is made of brick; but the floors, the plate cases, office desks, and other furniture are of wood. The great fire risk has long been a source of uneasiness to astronomers generally. Fortunately the danger has now been eliminated. Through the personal interest and generosity of members of the Visiting Commttee, a special fund has been provided for the protection of the plates. A complete, automatic, sprinkler system has been installed throughout the building, and water curtains provided for the windows and doors on the side nearest the large wooden Observatory buildings. We can now feel sure that the Harvard photographic collecton is secure from loss by fire. Tests have been made which show that damage by water need not be feared.

2. *The Henry Draper Catalogue.* Volume 99 of the *Harvard Annals,* which was completed and distributed during the past summer, is

the last of the nine volumes of the Henry Draper Catalogue. This extensive piece of work has been in progress for thirteen years, being planned in detail by Professor Pickering in 1911. The nine volumes contain for 225,300 stars the positions, the magnitudes, and the spectral classes as determined by Miss Cannon. The whole sky is covered by this survey, which is complete to magnitude 8.2 and also contains many thousands of stars as faint as magnitude 9 and 10. The interpretation of the large amount of material has been considered in various papers published during the year. Much remains to be done, however, and at several other observatories analyses of the material in the Henry Draper Catalogue are in progress.

The completion of the catalogue by no means exhausts the possibilities of the Harvard Observatory in classifying the spectra of faint stars. It is conservatively estimated that on spectrum plates now existing in the Harvard collection there are a million faint stars still unclassified. During the past year a considerable number of long-exposure plates have been made at Arequipa for the purpose of carrying on the work to fainter stars in selected regions. An extension of the catalogue is in progress, attention first being confined to regions of low galactic latitude, and to those parts of the northern sky for which the limit previously attained is not faint. Several thousands of these faint stars have now been classified by Miss Cannon, the laborious task of deriving photographic magnitudes is well advanced, and the first installment of the *Henry Draper Extension* will be issued during the coming year.

3. *Expedition to Chuquicamata.* The expedition to northern Chile from the Harvard Station at Arequipa, mentioned in last year's report, was carried out successfully by Mr. Paraskévopoulos. The site chosen is near Chuquicamata, at an altitude of about nine thousand feet. During the season that is cloudy at Arequipa he succeeded in obtaining a large number of photographs with two different telescopes. To see whether the Chilean location would also be better than Arequipa throughout the whole year, Mr. L. B. Aldrich, of the Smithsonian Institution, at a station near Chuquicamata, is making nightly records of the observing conditions.

Meanwhile it is planned to test another site during the coming cloudy season, this time at San José in Peru, not far from Arequipa. If the conditions at San José show marked improvement over Arequipa, it is probable that for the time being, as a matter of economy, we shall retain the present site for the permanent establishment, transferring each year some of the instruments to San José for the cloudy season only. Arequipa is highly satisfactory for eight months of the year.

The observational work at Arequipa has progressed very satisfactorily in the hands of Mr. and Mrs. Paraskévopoulos. More than two thousand photographs have been made, the library has been extended and catalogued, some of the instruments have been overhauled and

improvements made, and active photographic and visual work on variable stars has been begun.

4. *The Physical Chemistry of Stars.* Increasing knowledge of the structure of the atom and of its behavior under special conditions of pressure and temperature, have placed new emphasis on the detailed analysis of stellar spectra. During the year Miss Payne and Mr. Menzel have carried on important researches on the relative intensities of the absorption lines in different spectral classes. The observations are made almost wholly on spectrum plates already in existence in the Harvard collection. In particular, Miss Payne has been able to revise the temperature scale for the hotter stars, and to predict some of the higher ionization potentials for the lighter elements. The work on spectrum analysis has been expedited by the use of a new Moll thermoelectric microphotometer, which has been provided with the aid of grants from the American Academy of Arts and Sciences and the National Academy of Sciences. The study of stellar chemistry will be continued, with special emphasis on the stars of Class O and on the problems related to the temperature, density, and abundance of various chemical elements in stellar atmospheres.

5. *Variable Stars in the Milky Way.* The Cepheid variable stars, and to a lesser extent the eclipsing binaries and long-period variables, afford valuable means of measuring great distances. With the perfection of photometric methods, it becomes possible to analyze any part of the stellar system in which variables occur, outlining its extent in various dimensions, and the frequencies of certain types of stars. The problem of the structure of the galactic system has been of special interest to the writer for several years, and plans have now been perfected to place on a systematic basis one part of the analysis of the Milky Way.

Three belts in low galactic latitude are being photographed continually at Cambridge and Arequipa, with exposures of sufficient length to show stars to the seventeenth magnitude. Each one of the two hundred fields, which completely cover the galactic belt, will be photographed over a period of four or five years from five to forty times annually. The accumulated material will be sufficient, in general, to determine the light-curves and periods of all variable stars to the sixteenth magnitude, or fainter. More than a hundred new variable stars already have been found during the early stages of this work, and some important preliminary deductions are possible concerning the extent of the Milky Way.

The systematic study of the accumulating material cannot be made without the special provision of three or four assistants. Probably the most important need of the Observatory at this time is the provision of funds for carrying on this study of variable stars. The work can be accomplished expeditiously at the Harvard Observatory because of suitable telescopes, the collection of early photographs, and the long

experience of the staff with photographic photometry and stellar variability.

6. *Magellanic Clouds.* Intermittent work on the Magellanic Clouds for the last twenty-five years has led finally to a determination of the distances and dimensions of these remarkable southern objects. Professor Issei Yamamoto has assisted during the past year in the study of variable stars in both clouds. His work on the periods of the variables, and the continuation of the work on magnitude sequences, have been the necessary steps in fixing the distances. Now that the distances are known, a wide field of investigation opens—namely, the derivation of the absolute luminosities of red variables, Class O stars, gaseous nebulae, globular clusters, stars of the P Cygni type, and other peculiar objects. It is of interest to reflect that we shall be able to find out more concerning the real brightness of such objects from a study of representatives that are one hundred thousand light years distant than we can learn from investigating those near at hand in the galactic system.

An investigation of the luminosity curve by the writer shows that in the Small Cloud there are a quarter of a million stars that are more than one hundred times as bright as the sun, some of which have fifty thousand times the solar luminosity and are the brightest invariable stars on record. It is easily shown that these same stars are of enormous dimensions, some probably approaching in diameter the size of Jupiter's orbit.

Various Researches. The numerous other investigations in progress at the Observatory may be inferred from the partial bibliography given in the complete report. A few items are selected for brief summary in the following paragraphs.

A photometric survey by the writer, with the assistance of Miss Ames, of the brighter spiral nebulae and the condensations in the spiral arms, leads to the conclusion that Jeans' theory of the origin of the stars from spiral nebulae is untenable in its present form. Either the spiral nebulae are not at all stellar, or the distances assumed and computed by Jeans are much too mall. The latter is almost certainly the case.

Thirty-five thousand observations of long-period variables have been received during the year and analyzed by Mr. Campbell. He has published the usual predictions and summaries, both of which have been widely used.

A report on the scientific value of lunar eclipses and directions for observing them in such a way as to give information concerning the structure of the earth's upper atmosphere have been prepared and published by Mr. Willard J. Fisher, who has been a volunteer associate at the Observatory during the past year. Officers on eighty ships of the navy of the United States coöperated in observing the lunar eclipse

of August 14, 1924, and the results are now under discussion by Mr. Fisher.

Mr. Luyten, in collaboration at times with Professor E. B. Wilson, has completed numerous studies in stellar statistics. He has given special attention to the luminosity law and to the mean absolute magnitudes of special groups of stars.

The Bruce 24-inch telescope is being systematically used at Arequipa for long exposures on fields of faint nebulae, in continuation of a general study of nebular distribution. Nearly three thousand new nebulae have been described during the year, adding conspicuously to our information concerning these objects in the southern galactic hemisphere.

The relative frequency of different classes of stars in space is shown by a study of the Henry Draper Catalogue. Dwarf stars predominate. Class gM is more common than Class B. Class A stars increase rapidly in luminosity with advancing spectral type.

A consideration of new variable stars in Sagittarius indicates that the bright star clouds in that region are not nearer than six kiloparsecs. A surprisingly large number of faint variables of long period are found in these distant star clouds.

In coöperation with the Kapteyn Astronomical Laboratory at Groningen, the Durchmusterung of Selected Areas has now been completed in Volume 103 of the *Harvard Annals*. Standard magnitude sequences have also been determined for a number of Kapteyn Special Regions, for the Magellanic Clouds, and elsewhere.

Continuing his work on stellar clusters, Mr. Bailey has found and is studying a large number of new variables. Improved values for the distances of the clusters will be one product of his investigation.

The faint star cloud N. G. C. 6822, thought by Perrine, Duncan, and Hubble to be analogous to the Magellanic Clouds, has been studied on Harvard plates, and the distance estimated by various methods to be about a million light years. It is the most remote object now on record, and apparenty lies well outside our Milky Way system.

Publications. The titles of papers appearing in the *Annals, Circulars,* and *Reprints* during the past year are given in the complete report to the president of Harvard University.

HARLOW SHAPLEY, *Director.*

OBSERVATORIO ASTRONOMICO
UNIVERSIDAD NACIONAL
LA PLATA, ARGENTINA

Personnel. Galdino Negri and José L. Negri resigned in April, 1924. The post of computer was filled in June by Juan M. García Balado; that of seismologist is at present vacant.

Equipment. The equipment has been increased by the purchase of a

long-wave wireless receiving set. The seismograph clocks were completely overhauled during the year.

Researches. The preparation of the catalogue of the zone —57° to —62° has been delayed by the discovery of several omissions and discrepancies in the ledger cards, necessitating a thorough revision of several operations which had been thought complete. The reduction of the zone —62° to —66° was completed and that of the zone —66° to —72° was continued. The meridian observations in the zone —72° to —82° and on the Kapteyn Selected Areas have been continued and the reductions are well in hand.

But little work on double stars was done during the year, as Mr. Dawson was absent on leave till December, and since his return has been chiefly occupied with the final reductions of the zone —57° to —62°. The large equatorial has been employed for the micrometric observation of comets and of (433) Eros.

The photographic observations of minor planets have been continued. In connection with this work the planet (1924 RK) was found and its orbit determined.

Parts of eight nights in March and April were devoted by Mr. Dawson to a determination of the latitude of the Observatory by the Talcott method with one of the Repsold transits. As soon as data are available to reduce this to the mean pole, a publication will be prepared in which this and several other unpublished determinations will be discussed. The present indications are that the value now given in the ephemerides needs a correction of about +1″.5. It is planned also to check up our longitude by means of the various wireless time signals.

The director has devoted considerable time to the improvement of the seismological observations, which are now yielding results of definite value.

The time service and the routine solar and meteorological observations have been continued.

Publications. Volume VIII of the *Publicaciones* was printed during the year and is now (November, 1924) being distributed. A discussion of the errors of graduation of the Gautier Meridian Circle is ready for printing as a further part of Volume VI. The publication of Volume VII (Zone —57° to —62°) has been delayed as above noted.

J. HARTMANN, *Director.*

LICK OBSERVATORY
UNIVERSITY OF CALIFORNIA
MOUNT HAMILTON, CALIFORNIA

Dr. F. J. Neubauer succeeded Dr. G. F. Paddock (resigned) as Acting Astronomer in charge of the Chile Branch of the Observatory, at Santiago, Chile, in January, 1924, and Mr. J. D. Sterck was trans-

ferred from Mount Hamilton to Santiago as Assistant in February, 1924; Mr. Hugo Benioff was appointed Assistant at Mount Hamilton, August 1, 1923; Miss Gladys Wallace succeeded Miss E. M. Thomas (resigned) as Secretary, in May, 1924; Miss Lona Crane, Library Assistant, resigned March 1, 1924; Dr. R. H. Baker, Martin Kellogg Fellow, resigned August 1, 1923.

The greatest improvement in the material condition of the Observatory during the year has been the installation of a new light and power system which brings alternating current to the mountain from the main power lines of the Pacific Gas and Electric Company in the Santa Clara Valley, and of a new telephone system. The special building program referred to in last year's report has been continued, and progress has been made in the reconstructoin of the director's house and in the erection of a reinforced concrete general shops building. There have been no noteworthy additions to the instrumental equipment.

It was anticipated that the observations of the total eclipse of the sun on September 10, 1923, would be one of the important scientific events of the year, but since clouds on that date, at our station near Ensenada, Lower California, prevented all observations, it will suffice to say that work in connection with the expedition absorbed practically all of Mr. Wright's time in the first quarter of the year, and a considerable fraction of the time of several other members of the staff, notably Messrs. Moore and Trumpler.

The 36-inch refractor has been used, as in preceding years, almost exclusively in furthering the programs of radial velocity determinations and of double star measurements. Messrs. Moore, Trumpler, Neubauer, Benioff, Sterck, Jacobsen and Kholodovsky secured, in all, 1064 spectrograms during the year. More than half of these were of stars brighter than 5.5 visual magnitude. It is expected that this program will be completed within a year. Often important series relate to stars in the Pleiades and other open clusters (by Trumpler), to Polaris (by Moore), and to the brighter Cepheid variable stars (by Jacobsen). The 93 Polaris plates were utilized by Moore and Kholodovsky in computing a new orbit for the four-day period system. This, when compared with the orbit depending upon the spectrograms secured in 1899, shows changes in several of the elements, particularly in the longitude of periastron, a fact of interest whether we regard Polaris as a binary system or as a pulsating star.

Mr. Trumpler's spectrograms of the Pleiades stars now provide accurate data on the spectral class of nearly all group numbers brighter than the photographic magnitude 11.5 and give evidence of a very close relationship between spectral class and absolute magnitude. His spectrograms of stars in other clusters are being used to check earlier results, obtained elsewhere, on the relationship between spectral class and

color index, and to determine the distances of the clusters. Mr. Jacobsen is utilizing his spectrograms, and a smaller number secured with the ultra-violet spectrograph attached to the Crossley reflector, in a qualitative study of the spectra of the brighter Cepheids.

The spectrographic program carried out at Mount Hamilton has been supplemented, as heretofore, by the work at the Chile Station of the Observatory. Mr. Paddock completed, in November, 1923, the program of securing spectrograms of the southern long-period variable stars with spectra of Class Md. In addition, he, and after January, 1924, his successor, Mr. Neubauer, with the assistance of Mr. Sterck, secured spectrograms of a selected list of stars of visual magnitude 5.5 to 5.7 and of certain spectroscopic binary stars discovered at the Chile Station.

To carry on the program of double star measurement, Mr. Aitken secured about 400 sets of measures of selected binary stars, chiefly close pairs of his own discovery. Special note may be made of the interesting system of o Ceti, the companion being found after attention had been directed to it by Dr. Joy of Mount Wilson, who had suspected its existence from peculiarities in the spectrum of the variable; also to A111, the orbit of which, computed during the year on the basis of Mr. Aitken's own measures, proves to have a period of only 10.5 years, a period shorter than that of all but two visual binaries, so far as now known.

In August, 1923, Mr. Tucker completed the series of observations of zenith stars referred to in the last report. His discussion of the observations gives $+37^\circ\ 20'\ 25''.54$ as the mean value of the normal latitude, and a revision of all latitude determinations made with this meridian circle in the 30 years' period from 1893 to 1924 gives no apparent reason for suspecting a change in the position of the instrument in this period, such as might have been produced by a shift in the crust of the earth at this point. The greater part of Mr. Tucker's time during the year has been devoted to the preparation for publication of the results of his meridian circle work since 1904.

The Crossley reflector has been used chiefly in securing spectrograms with the aid of the quartz-spectrograph. Mr. Pearce secured 125 plates of stars of Class B, for the purpose of a qualitative study of spectra of these stars in the ultra-violet region of the spectrum. Mr. Jacobsen's spectrograms with this instrument have already been noted. Mr. Wright, in charge of the Crossley reflector, has continued his studies of the novae, and has arrived at conclusions as to the nature of the transformations that take place in these bodies. It is probable that at the outbreak of a new star, an expanding nebulous envelope, of the character of that actually observed to surround Nova Aquilae 1918, is normally found. This appendage is the origin of the so-called nebular line spectrum of the nova. In the course of years there is a fading of this spectrum, due to the gradual dissipation of the envelope in its

expansion, and the spectrum of the central star becomes relatively strong, finally dominating the spectrum.

In the latter part of the year Mr. Moore completed the compilation of a *Third Catalogue of Spectroscopic Binary Stars,* which will contain 1054 stars having variable velocities, together with orbits for 248 systems. Mr. Moore has also made a study of the one-prism spectrogram of the solar corona obtained at the eclipse of September 21, 1922, and finds a displacement of the Fraunhofer lines corresponding to portions of the corona about 20′ east and 20′ west of the sun's limb toward the red of an amount, which, if interpreted as a Doppler effect, would give a velocity of recession of about 20 km/sec. This would seem to be evidence that the particles in the outer corona 20′ from the sun's limb, which are effective in sending us light, are receding from the sun.

Mr. Trumpler has measured the four principal plates taken with the 5-foot focus twin camera at the eclipse of September 21, 1922, together with the four corresponding companion plates taken at Tahiti. These plates, because of their large field, are specially adapted to test Einstein's law that the deflection of starlight varies inversely as the distance of the star from the sun's center. The results of the measures are in good agreement with this law, and thus supplement the conclusions, given in last year's report, derived from the measures of the plates taken with the 15-foot focus camera at the same eclipse.

Limitations of space forbid more than a passing reference to Mr. Benioff's studies on the electric theory of the formation of a comet's tail, and on the use of vacuum tubes in stellar photometers; to Mr. Aitken's continuation of the work on the general catalogue of double stars; to Mr. Carpenter's studies of the flash spectrum; to the preparations made to photograph Mars at the opposition of August, 1924; and to the various routine services rendered by members of the staff.

Popular interest in the Observatory is as strong as at any former time, as is evident from the constant requests for lantern slides, photographs, publications and information, and from the fact that more than 10,000 visitors were admitted during the year, nearly half of them on our public nights.

ROBERT G. AITKEN, *Associate Director.*

(*To be continued.*)

PHENOMENA FOR 1925.

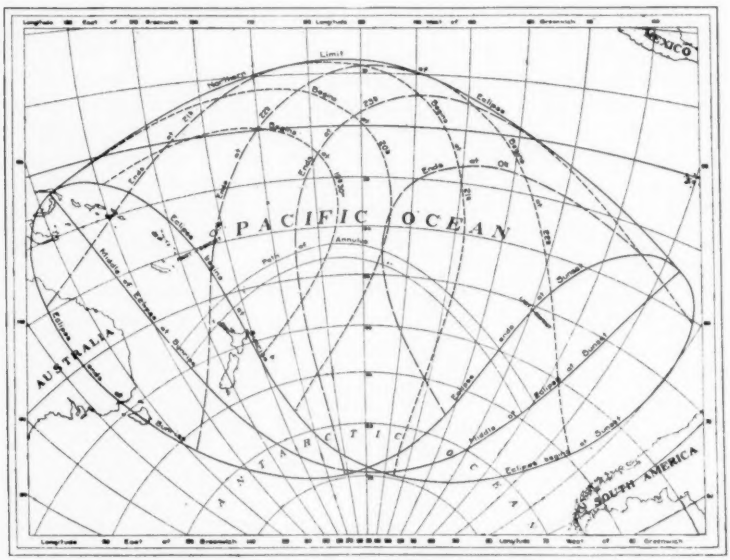
Eclipses.

During the year there will be four eclipses, two of the sun and two of the moon. The first of these will be the total eclipse of the sun on January 24. This eclipse was the subject of an article in the May, 1924, number of Popular Astronomy. On pages 4 and 5 will be found diagrams showing the entire path of totality and that portion passing over the United States, while the location of various eclipse parties will be found on pages 6 to 12.

The second eclipse will be a partial one of the moon on the night of February 8-9. The beginning will be visible generally in the western part of the Pacific Ocean, western Australia, Asia, the Indian Ocean, Europe, Africa, and the eastern part of the Atlantic Ocean; the ending visible generally in Asia, the Indian Ocean, Europe, Africa, the Atlantic Ocean, South America, and the eastern part of North America. The circumstances of this eclipse are as follows:

	Greenwich Civil Time		
	d	h	m
Moon enters penumbra	Feb. 8	18	48.1
Moon enters umbra	8	20	8.6
Middle of eclipse	8	21	42.0
Moon leaves umbra	8	23	15.4
Moon leaves penumbra	9	0	35.2

Magnitude of the eclipse = 0.735 (Moon's diameter = 1.0)



Annular Eclipse of July 20-21, 1925.
(The hours of beginning and ending are expressed in Greenwich Civil Time.)

The third eclipse will be an annular one of the sun, July 20-21. A diagram illustrating this eclipse will be found on page36. The circumstances of the eclipse are as follows:

	Gr. Civil Time	Long. from Greenwich	Latitude
	d h m	° ′	° ′
Eclipse begins	July 20 19 3.3	—173 47	—20 24
Central eclipse begins	20 20 26.0	—161 52	—37 32
Central eclipse at local apparent noon	20 21 56.7	+147 38	—25 51
Central eclipse ends	20 23 10.3	+100 17	—47 29
Eclipse ends	21 0 33.1	+109 44	—30 51

The fourth will be a partial eclipse of the moon, August 4. The beginning will be visible generally in western North America, western South America, the Pacific Ocean, Australia, and the northeastern part of Asia; the ending visible generally in the Pacific Ocean, Australia, eastern Asia, and the Pacific Ocean. The circumstances of this eclipse are as follows:

	Greenwich Civil Time		
	d	h	m
Moon enters penumbra	Aug. 4	9	24.8
Moon enters umbra	4	10	27.4
Middle of eclipse	4	11	52.6
Moon leaves umbra	4	13	17.6
Moon leaves penumbra	4	14	19.9

Magnitude of eclipse = 0.751 (Moon's diameter = 1.0).

It should be noted that the time used for the circumstances of the eclipses is Greenwich Civil Time instead of Greenwich Mean Time as heretofore. By general agreement G. M. T. has been given up in astronomical work and G. C. T. substituted, beginning Jan. 1, 1925. The G. C. T. day begins at midnight, 12 hours earlier than the day of the superseded G. M. T. To reduce G. C. T. to Central Standard Time subtract 6 hours.

The Sun.

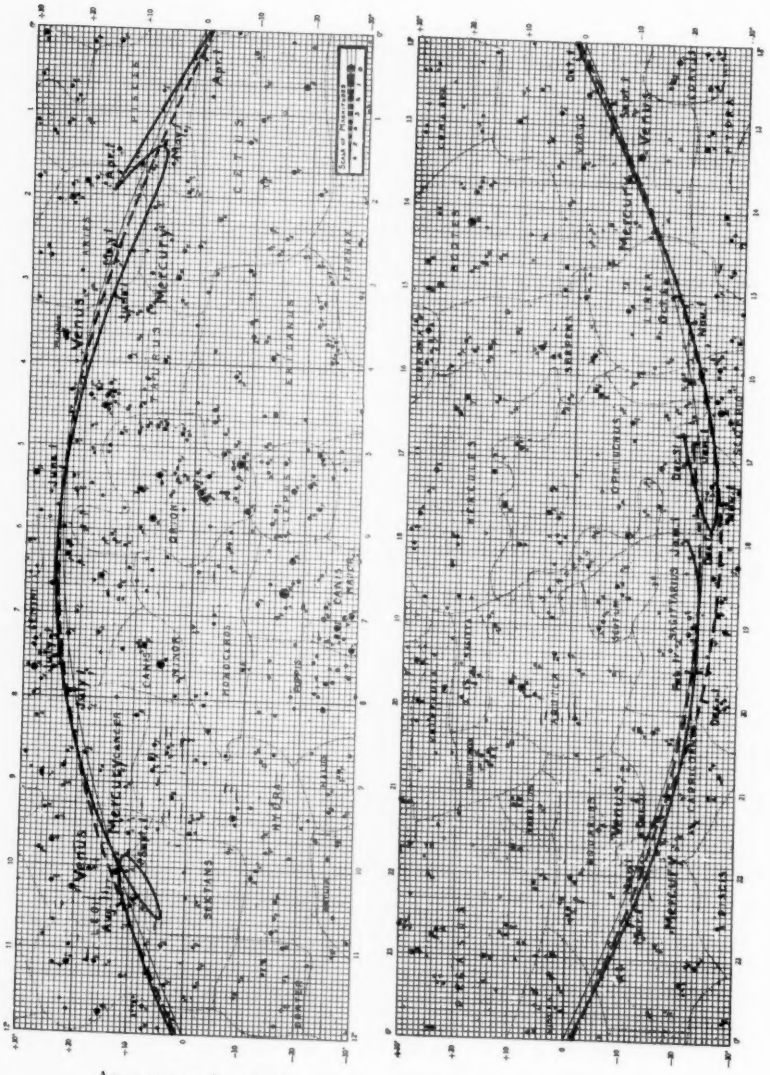
In addition to the eclipses already considered it will be desirable to watch for sun spots. The spot minimum is now past and we can expect an increase in the number of spots visible.

The sun enters the sign of Aries and spring begins March $21^d\ 3^h\ 13^m$ G. C. T.; it enters the sign of Cancer and summer begins June $21^d\ 22^h\ 50^m$ G. C. T.; it enters the sign of Libra and autumn begins Sept. $23^d\ 13^h\ 44^m$ G. C. T.; and it enters the sign of Capricornus Dec. $22^d\ 8^h\ 37^m$ G. C. T., which marks the beginning of winter.

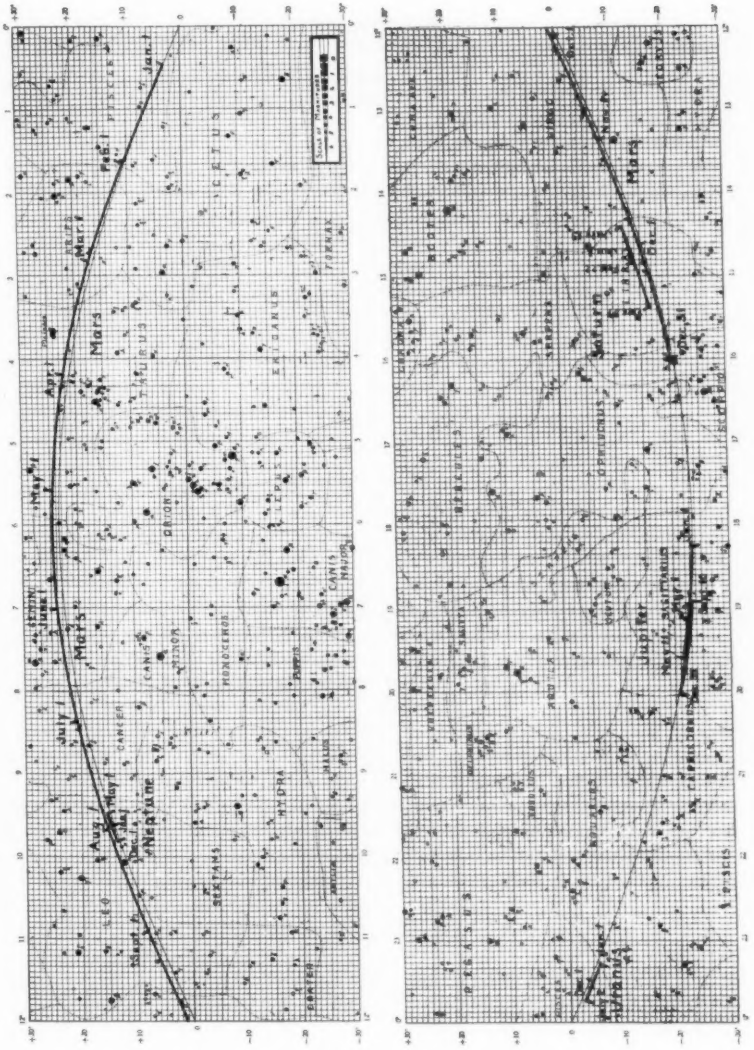
The Planets.

Mercury will be at greatest western elongation on the following dates, G. C. T.: Jan. $17^d\ 22^h$; May $16^d\ 11^h$; Sept. $11^d\ 0^h$ and Dec. $31^d\ 9^h$. Superior conjunctions will occur Mar. $5^d\ 13^h$; June $20^d\ 5^h$ and Oct. $7^d\ 8^h$. Greatest eastern elongations will come on Mar. $31^d\ 0^h$; July $28^d\ 16^h$ and Nov. $22^d\ 13^h$. Inferior conjunctions will occur on Apr. $18^d\ 17^h$; Aug. $25^d\ 9^h$ and Dec. $11^d\ 16^h$.

The planet begins the year in Sagittarius and moves directly until it reaches Aries. Retrograde motion from April 9 to May 1 takes it back into Pisces and then direct motion follows until August 10. Retrograde motion follows until September 3 and results in a loop in Leo and Sextans. Another period of retrograde motion in Ophiuchus follows in December, but by the 22nd of that month direct motion carries it eastward until well along into the following year.



Apparent paths of the planets Mercury and Venus, among the stars during the year 1925.

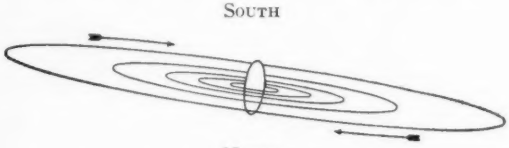


Apparent paths of the planets Mars, Jupiter, Saturn, Uranus and Neptune, among the stars during the year 1925.

Venus begins the year in Ophiuchus, completes more than a circuit of the heavens and ends the year in Capricornus. During the entire period its motion is direct.

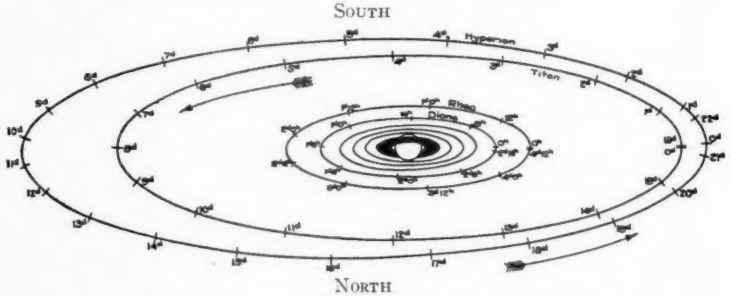
The planet will be at superior conjunction April 24 at 1^h and at greatest eastern elongation on November 28 at which time it will be 47° 17′ from the sun.

Mars begins the year in Pisces and ends it in Scorpio, moving eastward all the time. It will be in conjunction with the sun on September 13.



Apparent orbits of the satellites of Jupiter at date of opposition, July 10, 1925, as seen in an inverting telescope, and elongated in the ratio of three to one in the direction of their minor axes.

Jupiter will be in Sagittarius throughout the year. It will be at quadrature on April 11 and October 7 and in opposition on July 10 at 10^h.



Apparent orbits of the seven inner satellites of Saturn at date of opposition, May 1, 1925, as seen in an inverting telescope.

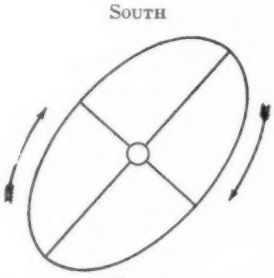
Saturn will be in Libra all the year. It will be at quadrature on February 3 and July 31, at opposition on May 1 and in conjunction with the sun on November 9.

Uranus begins the year at the boundary between Aquarius and Pisces but will be in the latter constellation most of the year. It will be in conjunction with the sun on March 12, at quadrature on June 17 and December 14; and in opposition September 16.

Neptune will be in Leo throughout the year, only a few degrees west and north of Regulus. Opposition will occur February 10, quadrature on May 11 and November 17 and conjunction on August 15.

There will be a number of close approaches of the planets this year. On February 3 at 8^h Mercury and Venus will be within 38′ of each other, on July 11, at 2^h G. C. T., Mercury will pass within 6′ of Venus and an hour later within 15′ of Mars. These three planets can then be seen in the same field in small

Apparent orbits of the satellites of Uranus at date of opposition, September 16, 1925, as seen in an inverting telescope.



Apparent orbit of the satellite of Neptune at date of opposition, February 10, 1925, as seen in an inverting telescope.

telescopes. On July 19 at 6^h Mercury and Neptune will be only 6′ apart and on July 20 at 19^h Venus passes within 1° 19′ of Neptune.

For the information on eclipses and planets we are indebted to the *American Ephemeris* of 1925.

SATELLITES.

As heretofore we shall publish the configurations of the satellites of Jupiter and Saturn when these planets are in suitable position for observation.

COMETS.

The comets which have been discovered in 1924 are all practically beyond reach with the ordinary telescope. Several periodic comets are due at perihelion during the year 1925, but most of them under unfavorable conditions for observation, or with elements so uncertain that their place can not be predicted accurately. The list is as follows:

1. Faye's comet.—This should have been at perihelion in September, 1924, but under unfavorable conditions and so far as we know has not been seen. It may possibly be picked up in January or February, 1925.

2. Comet 1881 V (Denning).—This we believe has never been seen since 1881. If the period 8.758 were correct the comet should be due at perihelion about May 30, but unfavorably situated for observation.

3. Comet 1892 V (Barnard).—The same remarks may be made about this comet as concerning Denning's.

4. Comet 1886 IV (Brooks).—This is another comet which has been observed only at one apparition and so the elements are too uncertain to predict its exact place. According to the old elements it should be at perihelion about July 30, and in fair position for observing in September.

5. Comet Tempel-Swift.—This has been seen several times and should be at perihelion about October 11, and in good position for observing during September and October.

6. Comet 1905 II (Borrelly).—This should be near perihelion about October 19, and in only fair position for observing. It may be picked up during the summer.

7. Wolf's Periodic Comet should be at perihelion about the middle of October and in very good position for observing for three or four months.

8. Comet 1889 V (Brooks).—This was last seen in 1910, when it was just at the limit of vision with the great Lick telescope. It should be near perihelion about November 8, but it is doubtful whether it can be seen except with the aid of the very largest telescopes. An ephemeris of this comet is given in *Astronomische Nachrichten* No. 5332, covering the entire year 1925. It should be brightest about the first of October.

9. Comet Tempel II should be near perihelion toward the end of December, but will then be on the opposite side of the sun from the earth and so can not be seen.

10. Comet 1906 II (Kopff) is not due at perihelion until the latter part of January, 1926, but will then be opposite the sun. It may be picked up during the autumn of 1925.

OCCULTATIONS.

The *American Ephemeris* lists 7 occultations of Aldebaran, 4 of Regulus, 7 of Neptune, 2 of Venus and 2 of Jupiter for the year. For those visible in the United States we hope to be able to publish maps by Father Rigge as in 1924. Other occultations will be given monthly from the *Ephemeris* lists of those visible at Washington.

PLANET NOTES FOR FEBRUARY.

The *Sun* will move northeastward from $20^h\ 56^m$, $-17°\ 18'$ to $22^h\ 46^m$, $-7°\ 51'$ during February. It will pass from the constellation Capricornus into the constellation Aquarius. It will not pass near any conspicuous star during this month. The earth will recede from the sun a distance of about half a million miles during this period.

The phases of the *moon* will occur as follows:

Full Moon	Feb. 8 at 4 P.M.	C.S.T.
Last Quarter	16 " 4 A.M.	"
New Moon	22 " 8 P.M.	"

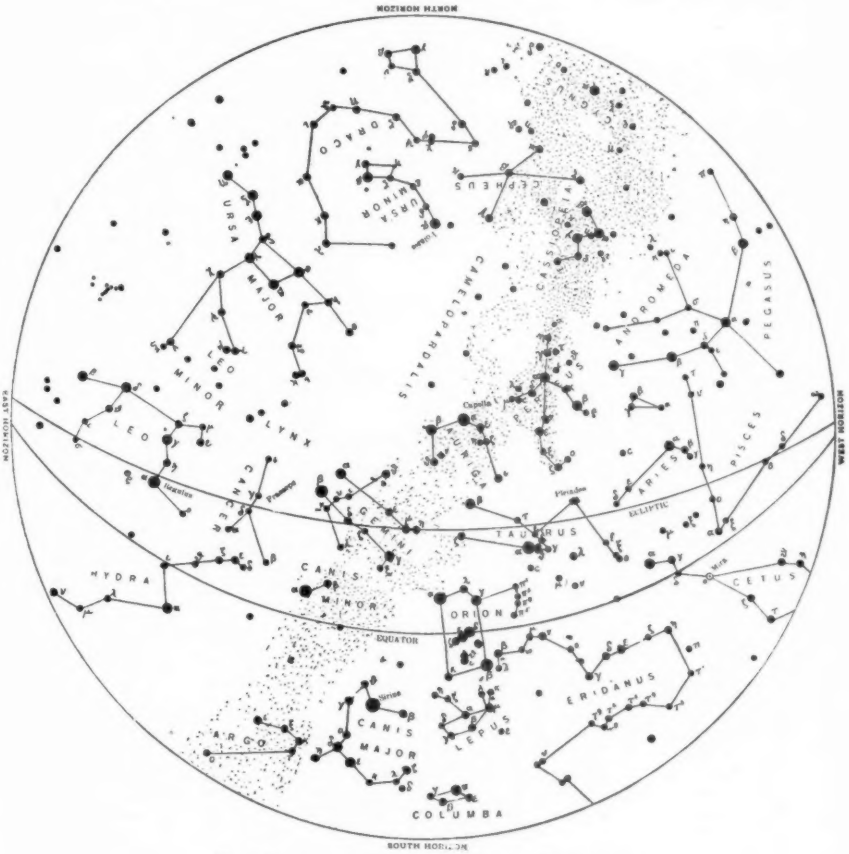
The phase "First Quarter" will occur on the last day of January and the next one will occur early in March but none will fall in February this year. The moon will come nearest the earth on February 20 and will be farthest away on February 4.

Mercury will be moving eastward a little more rapidly than the sun. At the beginning of the month it will be a little more than an hour west of the sun and at the end of the month it will have nearly caught up with the sun. This planet therefore cannot be studied during this period.

Venus also will be following the sun rather closely in its motion eastward. Like Mercury it will be too close to the sun to be studied. On February 3 these two planets will be in the same right ascension and less than a degree apart in declination. They will be about an hour west of the sun and a few degrees south of it. Therefore, just before sunrise on this date these planets may be seen together in a small telescope or with field glasses. Venus, which is easily recognized, will aid the inexperienced amateur in finding Mercury which might otherwise be difficult to find. A further note concerning these planets will be found on page 73 of this issue.

Mars will be visible in the western sky in the early evening. It will cross the meridian about four thirty. At the end of the month it will be 155,000,000 miles from the earth and will be a bit fainter than a first magnitude star. It will be moving eastward in the constellation Aries.

Jupiter will be coming into position for observation in the morning sky. Be-



THE CONSTELLATIONS AT 9:00 P. M. FEBRUARY 1.

cause of its south declination of nearly 23° it will not yet be well situated for northern observers. It will be moving eastward slowly in Sagittarius.

Saturn will be in quadrature with the sun on February 3. It will then be on the meridian at sunrise and well situated for morning observation. It will be about 14 degrees south of the equator in the constellation Libra.

Uranus will still be visible in the western sky after sunset. The sun, however, will be moving towards it and will pass it early in March.

Neptune will be in opposition to the sun on February 10. It will be in the constellation Leo, a short distance northwest of Regulus.

Occultations Visible at Washington.

[*From the American Ephemeris*]

Date 1925	Star's Name	Magnitude	IMMERSION. Washington C.T.	IMMERSION. Angle from N	EMERSION. Washington C.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
Feb. 2	α Tauri	1.1	16 44	128	17 28	192	0 44
6	10 H. Cancri	6.1	21 30	34	22 12	340	0 42
8	11 Leonis	6.5	17 14	112	18 9	263	0 54
8	Neptune	7.7	17 40	94	18 38	282	0 58
8	ψ Leonis	5.6	20 15	139	21 14	245	0 59
15	13 Librae	5.7	3 39	133	4 56	281	1 17
16	190 B. Librae	6.5	0 34	141	1 25	261	0 51
25	26 Ceti	6.0	19 20	100	20 12	217	0 52
27	μ Ceti	4.4	20 19	82	21 26	246	1 7

VARIABLE STARS.

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1925 February					
	h m	° ′		d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7		20 13				
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	7 14	15 17	23 20			
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	8 5	15 23	23 17			
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2		14 15				
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	6 18	14 17	22 15			
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	6 20	14 15	22 10			
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	7 2		23 11			
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	4 17	13 7	21 20			
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	3 17	14 20	25 23			
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	5 8	16 23	28 14			
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	6 4	13 20	21 12			
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	7 23	18 2	28 5			
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	7 17	15 10	23 3			
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	4 2	9 14	20 16	26 4		
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	2 14	10 4	17 17	25 7		
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3		11 3				
R Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	8 4	15 15	23 2			
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	1 1	8 23	16 21	24 19		
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	2 1	12 5	22 9			
RU Camelop	7 10.9	+69 51	8.5— 9.8	22 06.5	8 4					
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	7 12	15 11	23 10			
V Carinae	8 26.7	—59 47	7.4— 8.1	6 16.7	4 4	10 21	17 14	24 6		
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	3 17	12 23	17 15	26 21		
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	1 13	10 7	19 1	27 19		

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1925 February							
	h m	° ′		d h	d h		d h		d h		d h	
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7					21 18			
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	6 21		13 16		20 11		27 6	
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	4 13		17 18		24 8		30 23	
S Muscae	12 07.4	—69 36	6.4— 7.3	9 15.8	2 10		12 2		21 18			
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	6 3		14 3		22 2			
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	2 15		9 8		22 19		29 13	
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	2 11		8 7		19 23		25 18	
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	4 19		14 4		18 21		28 6	
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5			12 0				29 7	
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	3 7		11 12		19 17		27 22	
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	5 18		12 18		19 19		26 19	
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	7 22		15 8		22 17			
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	2 10		7 22		18 22		24 19	
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	1.15		9 5		16 18		24 7	
R Triang.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	4 19		11 14		18 8		24 3	
S Triang.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	4 2		10 10		16 17		23 1	
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	5 13		15 7		25 1			
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	2 18		11 14		20 11			
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	4 13		10 14		16 16		22 17	
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	9 22		16 22		23 22		30 23	
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9	7 0				24 3			
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	1 4		8 19		16 9		23 23	
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	5 3		10 22		22 11		28 6	
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	7 11		14 5		20 23		27 17	
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3			9 20		20 4		30 12	
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	5 6		12 22		20 14		28 6	
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	8 6		15 17		23 3			
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	3 6		12 8		21 10			
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	1 11		8 11		15 12		22 12	
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	2 7		9 7		16 7		23 6	
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	1 18		9 18		17 17		25 17	
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	4 13		12 5		19 22		27 15	
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	3 19		10 23		18 3		25 8	
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	5 23		14 9		22 18			
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	5 23		12 7		18 15		24 22	
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	2 8				18 17			
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	3 4		12 1		16 12		25 9	
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	1 16		8 10		15 3		21 21	
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	7 10		14 3		20 20		27 13	
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	8 12				22 5			
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	1 13		9 10		17 7		25 3	
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	5 23		12 20		19 17		26 15	
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	1 4		10 21		15 18		25 11	
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	8 21		17 12		26 4			
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	2 8		7 17		18 11		23 20	
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1			11 18		22 16			
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	4 2		10 12		16 22		23 8	
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	5 3		10 3		20 2		25 2	
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	6 6		11 17		22 15		28 1	
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	3 9		8 20		19 17		25 3	
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	2 3		8 10		21 0		27 7	
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	4 10				17 13			
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	3 0		9 23		16 23		23 22	

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1925 February							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8	3 5							
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	6 8	14 0	21 16					
U Cephei	0 52.4	+81 20	7.0— 9.0	1 11.8	2 8	9 20	17 7	24 18				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	1 2	7 5	19 10	25 13				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	8 13	17 3	25 17					
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	4 10	11 7	18 4	25 0				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	3 14	10 18	17 22	25 2				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	2 3	10 22	19 17	28 11				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	2 18	10 17	18 16	26 14				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6			18 21					
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8		9 14	18 4	26 16				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	6 15	13 10	20 5	27 0				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	5 12	13 9	21 6					
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	5 15	14 0	22 6					
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	5 9	13 7	21 4					
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	7 11		20 16					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	5 2	11 9	17 16	24 0				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	1 8	13 18	26 4					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	4 17	11 9	18 1	24 16				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	1 11	9 16	17 20	26 0				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	3 12	9 12	21 13	27 14				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	5 18	14 10	23 2					
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9		10 0	20 10					
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	1 7	9 7	17 7	25 8				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	1 5	6 22	18 9	24 2				
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	3 22	9 12	20 17	26 7				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08 8	5 19	14 0	22 5					
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	2 19	10 10	18 0	25 16				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	2 17	14 22	27 3					
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	8 3	15 7	22 11					
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	7 11	14 6	21 2	27 21				
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2	9 9	18 16	27 23					
Y Canelop.	27.6	+76 17	9.5—12	3 07.3	5 9	12 0	18 15	25 5				
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	1 10	9 19	18 5	26 14				
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	2 21	9 7	22 4	28 14				
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	2 21	10 4	17 10	24 17				
X Carinae	8 29.1	—58 53	7.9— 8.7	0 13.0	6 20	14 22	23 1					
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	8 22	18 9	27 21					
RX Hydrae	9 00 8	— 7 52	9.1—10.5	2 06 8	5 4	12 0	18 20	25 16				
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	1 2	7 0	18 21	24 20				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	3 13	10 7	17 1	23 19				
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	3 13	10 23	18 9	25 19				
SS Carinæ	10 54.2	—61 23	12.2—12.8	3 07.2	6 17	13 8	19 22	26 12				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	5 2	13 21	22 16					
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	1 17	9 1	16 9	23 17				
Z Draconis	12 39.8	+72 49	9.9—13.6	1 08.6	3 7	10 2	16 21	23 16				
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	4 8	11 20	19 8	26 20				
RS Can. Ven	13 06.3	+36 28	7.5—12.5	4 19.1	2 9	12 0	21 14					
SS Centauri	07.2	—63 37	8.8—10.4	2 11.3	4 12	11 22	19 9	26 19				
SX Hydræ	13 39.0	—26 23	8.6—12.7	2 21.5	2 20	8 15	20 5	26 0				

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1925 February							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
δ Libræ	14 55.6	— 8 07	4.8— 6.2	2 07.9	4 9	11 9	18 8	25 8				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	2 13	9 11	16 8	23 6				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	6 19	15 5	23 15					
SS Libræ	15 43.4	—15 14	9.3—11.5	0 18.4	2 16	9 20	17 1	24 6				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	6 8	13 16	21 0	28 8				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	7 10	15 16	23 23					
R Aræ	31.1	—56 48	6.8— 7.9	4 10.2	3 18	12 15	21 11					
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1		12 8						
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	7 4	13 23	20 18	27 14				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	2 18	11 3	19 12	27 22				
ω Herculis	13.6	+33 12	4.6— 5.4	2 01.2	3 3	9 7	21 15	27 18				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	5 10	11 14	17 18	23 23				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	7 15	15 0	22 9					
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	8 17	16 21	25 1					
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	5 5	12 18	20 7	27 20				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	6 23	14 17	22 10					
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	8 19	16 18	24 18					
WX Sagittarii	53.6	—17 24	9.2—10.8	2 03.1	7 2	15 15	24 3					
WY Sagittarii	17 54.9	—23 01	9.5—10.6	4 16.0	3 10	12 18	17 10	26 18				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	2 1	12 9	17 13	27 21				
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	6 18	14 0	21 6	28 12				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	1 3	8 1	21 21	28 19				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2		12 15		27 18				
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	4 19	11 23	19 3	26 7				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	1 18	8 21	23 3	30 5				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	2 16	11 0	19 7	27 14				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	5 1	13 12	22 1	30 12				
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	5 18	12 10	19 1	25 17				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	5 17		18 14					
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	5 17	13 8	20 23	28 15				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	3 20	11 10	18 23	26 13				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	6 11	13 15	20 20	28 1				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	7 6	16 5	25 4					
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	4 6	11 0	17 18	24 12				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	7 21	15 6	22 14					
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	3 12	8 18	19 5	24 11				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	4 6	10 18	17 7	23 19				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	6 0	12 0	18 0	24 0				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	2 13	9 5	15 20	22 11				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	2 17	7 7	16 11	25 14				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	7 8	15 18	24 5					
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	7 11	14 6	21 1	27 20				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	1 11	8 9	15 6	22 4				
V Vulpec	32.3	+26 15	8.2— 9.8	37 19.0		14 15						
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	9 7	18 22	28 12					
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	4 7	13 12	22 17					
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	4 19	13 19	22 19					
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	5 9	12 23	20 13	28 4				
RR Vulpec	20 50.5	+27 32	9.6—11.0	5 01.2		10 20	20 23					
RY Aquarii	21 14.8	—11 14	8.8—10.4	1 23.2	4 13	12 10	20 7	28 4				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3		14 2						
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	1 2	11 5	21 9					
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	2 23	13 8	18 13	28 22				
VW Pegasi	51.7	+32 42	10.0—10.6	5 06.4	2 23	8 5	18 18	24 0				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	7 5	14 17	22 6					
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	1 3	9 9	17 15	25 20				

Minimum of RR Sagittarii.—There has been uncertainty as to the minimum magnitude of the long period variable RR Sagittarii, *194929*. In the Vierteljahrsschrift der Astronomischen Gesellschaft for 1924 the minimum light is given as 11.6? and in Harvard Circular 259 the visual minimum for 1923 is given as 13.0.

On plates taken at Arequipa in 1924, with the Bruce 24-inch telescope, the photographic minimum has been found to be 14.6 on Julian Day 2423949. The Julian Day of the last preceding minimum in 1923 (H. C. 259) is 2423614, which gives a period of 335 days, quite in agreement with the period already established.

Harvard College Observatory Bulletin 810. (J. S. P.)

RW Hydrae.—The southern red variable RW Hydrae, *132824*, was discovered at the Harvard Observatory by Mrs. Fleming. Its spectrum is somewhat peculiar in that Hβ is generally bright and strong. The brightest portion of the spectrum is between Hβ and Hγ. Miss Cannon gives the underlying class as Ma in the remarks to the Henry Draper Catalogue. Nothing has been published heretofore concerning the variations in light.

Professor Issei Yamamoto has now examined the star on about six hundred plates of the AC and AM series, from 1899 to 1923. He finds that the mean period is 370 days, but the interval between minima fluctuates from 360 to 380 days. A minimum occurred on Julian Day 2423190. The minima are better defined than the maxima, and the star brightens more rapidly than it fades. The mean photographic magnitudes at maximum and minimum, respectively, are 9.9 and 10.8, with extremes of 9.7 and 10.9. The star is clearly abnormal for a long period variable.

Harvard College Observatory Bulletin 810.
Cambridge, Massachusetts, December 1, 1924.

Monthly Report of the American Association of Variable Star Observers, Received Sept. 20—Nov. 30, 1924.

The Association welcomes the observations of three new contributing members, Messrs. C. W. Hubbard, Greenwich, Conn., W. M. Kearons, Fall River, Mass., and Horace Marks, Nantucket, Mass. Mr. D. F. Brocchi is using his newly constructed 12-inch reflector with evident success, and Mr. Cilly has been given the use of the 6-inch refractor at Adelphi College, New York. Mr. Skaggs reports the completion of his new observatory at Oakland, Cal. The Association is much indebted to Professor J. R. Jewett for the loan of a 5-inch refractor. It is with regret that we learn that Mr. F. J. Carr, of Swanton, Vt., is obliged to give up active observing for the present. He has been doing good work with the 4-inch Robinson Telescope and we hope he will be able to resume observing later on.

R Coronae, 154428, has practically reached normal maximum brightness, magnitude 6.0, after a drop, lasting two months, to a minimum of the ninth magnitude. No maxmum of SS Aurigae, 060547, has been reported since August 20, and the frequency and continuity of observations appears to indicate that none has escaped our attention. This star, as well as U Geminorum, 074922, should be carefully observed by members with the larger telescopes. The ninth maximum for the year for SS Cygni, 213843, commenced at the end of November and was one of the slow-rising type.

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER AND NOVEMBER, 1924.

Sept 0 = J. D. 2424029 Oct. 0 = J. D. 2424059 Nov. 0 = J. D. 2424090

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
000339 V SCULPTORIS—						
	3972.2	13.8	Bl	4017.1	12.0	Bl
	3994.1	12.9	Bl	4058.1	10.0	Bl
	4003.1	12.3	Bl			
001032 S SCULPTORIS—						
	3994.1	10.2	Bl	4060.8	8.5	Pt
	4003.1	9.5	Bl	4075.9	7.9	Kd
	4017.1	9.5	Bl	4084.0	7.6	Kd
	4058.1	8.8	Bl			
001046 X ANDROMEDAE—						
	4051.8	9.1	Bi	4085.6	9.3	Hu
	4055.7	8.8	Wf	4088.5	10.4	Mz
	4064.7	8.8	Wf	4088.6	10.4	Al
	4068.6	9.2	Ie	4090.6	12.2	Ie
	4071.6	10.0	Al	4091.7	10.2	Bi
	4072.7	9.4	Bi	4093.5	10.3	B
	4084.8	9.6	Bi			
001620 T CETI—						
	4024.4	6.1	L	4062.0	6.3	Kd
	4037.6	6.2	An	4075.9	6.3	Kd
	4046.0	6.4	Kd	4077.3	6.6	An
	4047.4	6.2	An	4078.4	6.1	L
	4048.5	6.0	L	4084.0	6.4	Kd
	4056.3	6.1	Kd	4088.4	6.1	An
	4058.4	6.2	An			
001726 T ANDROMEDAE—						
	4047.6	11.5	Ie	4074.5	9.5	Mz
	4051.9	10.9	Bi	4078.6	9.5	Cu
	4053.6	11.2	Mz	4084.6	9.6	Jo
	4053.6	11.6	Pt	4084.6	9.3	Mz
	4055.1	9.1	Ch	4084.8	9.2	Bi
	4055.7	11.6	Br	4086.6	9.6	Pt
	4061.6	10.4	Mz	4087.6	9.2	B
	4066.7	10.1	Lv	4088.5	9.2	Mz
	4069.6	9.5	Ie	4091.5	9.2	Mz
	4072.7	10.1	Bi	4094.6	9.1	Ie
001755 T CASSIOPEIAE—						
	4031.7	8.5	Sg	4071.6	8.3	Cu
	4046.6	8.7	L	4075.6	7.9	L
	4047.6	9.4	Jo	4076.6	8.2	Jo
	4048.6	9.0	Du	4076.8	7.6	Sg
	4050.6	9.1	Cm	4082.5	8.0	B
	4053.6	8.9	Mz	4082.6	7.9	Jo
	4053.6	8.6	Pt	4084.6	7.9	Mz
	4056.6	9.0	Jo	4084.8	7.6	Al
	4061.5	8.9	Ca	4086.6	8.1	Pt
	4061.6	9.1	Mz	4090.6	7.7	Ie
	4064.4	8.2	L	4091.5	7.8	Mz
	4068.6	8.4	Ie	4093.5	7.7	B
	4068.6	8.8	Mz	4104.6	7.5	B
	4071.6	7.9	Al			
001838 R ANDROMEDAE—						
	4052.6	13.0	Ie	4083.8	14.5	Pa
	4056.8	13.3	Br	4086.6	13.6	Pt
	4077.7	14.0	Br	4087.8	14.6	Pa
	4078.6	13.8	Ie			
001862 S TUCANAE—						
	3994.1	[14.0	Bl	4058.1	10.6	Bl
	4017.1	[13.2	Bl			
001909 S CETI—.						
	4047.1	8.2	Ch	4072.5	8.5	Cu
	4047.6	8.0	Ie	4075.5	8.6	L
	4050.6	8.4	Ca	4082.6	8.8	Cu
	4053.6	8.5	Pt	4082.8	8.5	Sg
	4055.6	8.5	Ca	4084.6	8.7	Mz
	4057.1	8.2	Ch	4086.6	8.6	Pt
	4060.8	8.2	Mz	4091.5	9.6	Mz
	4063.6	8.4	Mz	4093.6	9.6	Mz
	4066.2	8.4	Ch	4094.6	9.3	Ie
	4069.6	8.5	Ie			
002546 T PHOENICIS—						
	3994.1	13.4	Bl	4058.1	[13.6	Bl
	4017.1	13.0	Br			
002833 W SCULPTORIS—						
	3994.1	12.6	Bl	4058.1	12.8	Bl
	4017.1	[12.8	Bl			
003179 Y CEPHEI—						
	4054.8	15.0	Pa	4087.8	13.7	Pa
	4059.8	15.0	Pa	4108.8	13.0	Pa
	4080.8	13.3	Pa			
004047 U CASSIOPEIAE—						
	4031.7	[12.4	Sg	4078.5	8.8	Cu
	4053.6	10.8	Mz	4078.7	8.5	Sg
	4053.6	11.0	Pt	4082.5	8.5	Ie
	4054.6	10.3	Ie	4084.8	8.4	Br
	4055.8	10.8	Wf	4086.6	8.5	Pt
	4059.7	10.2	Pa	4093.5	7.9	B
	4061.7	10.1	Mz	4088.5	9.0	Mz
	4064.7	10.0	Wf	4091.5	8.7	Mz
	4072.7	9.1	Bi	4104.6	7.2	B
	4074.5	9.5	Mz			
004132 RW ANDROMEDAE—						
	4056.8	13.4	Bi	4088.6	10.7	Mz
	4077.7	12.4	Br	4090.6	10.6	B
	4083.5	11.8	Ie	4105.5	8.7	B
	4086.6	11.9	Pt			
004435 V ANDROMEDAE—						
	4056.8	13.8	Br	4076.6	13.8	Br
	4066.7	13.5	Lv	4084.8	13.5	Bi
004435 X SCULPTORIS—						
	3994.1	[13.6	Bl	4058.1	[13.6	Bl
004533 RR ANDROMEDAE—						
	4052.6	8.7	Hu	4088.6	9.4	Al
	4055.8	9.2	Wf	4088.6	9.6	Mz
	4064.7	9.3	Wf	4094.5	9.9	B
	4085.6	9.2	Hu			
004746a RV CASSIOPEIAE—						
	4048.6	9.2	Du	4064.8	9.4	Wf
	4053.6	9.2	Pt	4086.6	9.2	Pt
	4054.6	9.0	Ie	4093.5	9.3	B
	4055.8	9.3	Wf			

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER AND NOVEMBER, 1924.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
004746b — CASSIOPEIAE—						
	4053.6	10.4	Pt	4082.6	9.7	Ie
	4054.6	10.7	Ie	4086.6	9.1	Pt
	4082.6	9.0	Ie			
004958 W CASSIOPEIAE—						
	4024.6	10.8	Cg	4086.6	9.1	Pt
	4053.7	9.8	Pt	4088.6	11.2	Mz
	4053.7	11.9	Mz	4191.5	10.6	B
	4078.6	10.7	B			
005475 U TUCANAE—						
	3972.9	13.3	Bl	4017.1	9.9	Bl
	3994.1	11.2	Bl	4058.1	8.2	Bl
	4003.1	10.4	Bl			
005840 RX ANDROMEDAE—						
	4055.7	12.2	Br	4078.7	12.5	Br
	4064.7	13.8	Br	4081.7	13.5	Br
	4075.6	11.2	Br			
010102 T CETI—						
	4056.8	11.2	Br	4086.6	8.8	Pt
	4093.6	[12.0	B			
010630 U SCULPTORIS—						
	3994.1	13.5	Bl	4058.1	10.7	Bl
010940 U ANDROMEDAE—						
	4056.8	13.4	Br	4087.8	14.0	Pa
	4077.7	13.5	Br	4104.5	[13.4	B
	4083.5	13.1	Ie	4108.8	14.0	Pa
	4083.8	13.6	Pa			
011041 UZ ANDROMEDAE—						
	4055.6	13.3	Ie	4087.6	10.3	B
	4055.8	13.3	Wf	4083.5	11.1	Ie
	4056.8	13.6	Br	4088.6	10.8	Mz
	4064.8	13.1	Wf	4104.5	10.3	B
	4077.7	12.2	Br			
011208 S PISCIUM—						
	4056.8	13.7	Br	4079.6	10.7	Y
	4059.8	12.2	Pa	4087.6	10.0	B
	4077.7	10.4	Br	4104.6	10.0	B
011272 S CASSIOPEIAE—						
	4054.8	15.5	Pa	4080.8	14.8	Pa
	4059.8	15.4	Pa	4084.9	13.1	Bi
	4075.6	14.3	Wf	4087.8	14.0	Pa
	4076.6	14.2	Br	4095.8	13.0	Sg
	4078.6	13.9	Ie	4107.5	12.8	Ie
	4080.7	14.5	Sg	4108.8	13.5	Pa
011712 U PISCIUM—						
	4056.9	13.1	Br	4077.7	13.7	Br
	4059.7	13.4	Pt	4090.8	15.2	Pa
	4066.7	14.5	Br	4108.8	14.6	Pa
012350 RZ PERSEI—						
	4056.9	13.8	Br	4089.6	12.6	Y
	4077.8	13.2	Br	4091.6	12.2	B
012502 R PISCIUM—						
	4056.9	13.0	Br	4080.8	13.8	Pa
	4059.8	13.6	Pa	4085.7	13.5	Lv
	4077.8	13.3	Br	4087.8	14.2	Pa
013238 RU ANDROMEDAE—						
	4047.6	10.5	Ie	4076.6	10.0	Al
	4053.6	10.4	Pt	4086.6	10.0	Pt
	4055.1	10.0	Bi	4087.6	10.2	B
013238 RU ANDROMEDAE—Continued.						
	4056.7	10.4	Wf	4093.6	10.6	Ie
	4064.8	10.2	Wf	4101.5	10.5	B
	4070.6	10.0	Ie			
013338 Y ANDROMEDAE—						
	4053.6	12.1	Pt	4088.6	10.3	Al
	4055.1	11.8	Ch	4093.6	9.1	B
	4056.8	11.3	Br	4104.6	9.2	B
014958 X CASSIOPEIAE—						
	4053.6	9.8	Pt	4087.6	9.8	B
	4086.6	9.4	Pt	4101.5	10.6	B
015354 U PERSEI—						
	4053.6	8.4	Pt	4078.7	8.5	Sg
	4061.6	8.3	Ks	4084.6	8.7	Al
	4061.7	8.2	Mz	4085.6	8.2	Hu
	4062.5	8.4	Ca	4093.6	7.8	Mz
	4076.6	8.4	Al	4093.6	8.0	B
	4076.6	8.0	Hu	4104.6	8.5	B
015912 S ARIETIS—						
	4059.8	15.1	Pa	4104.5	[14.0	B
	4080.8	15.3	Pa	4108.8	14.0	Pa
	4087.7	14.5	Pa			
021024 R ARIETIS—						
	4051.6	11.6	Ks	4088.7	9.6	Ms
	4053.6	11.9	Pt	4088.7	9.7	Mz
	4054.6	11.6	Ie	4089.6	9.4	Ms
	4055.6	11.6	Cy	4090.6	9.0	Mx
	4060.7	11.0	Mz	4091.5	9.1	Mz
	4061.6	10.7	Ca	4091.5	9.0	Mx
	4063.8	11.0	Br	4091.6	9.0	Ms
	4076.7	11.3	Cy	4091.6	9.1	B
	4076.7	11.4	Hy	4091.6	9.0	Ly
	4081.6	9.7	Ie	4093.6	9.1	Mz
	4082.6	9.9	Cu	4103.5	8.7	Ms
	4082.7	10.3	Ms	4103.5	8.7	Mx
	4083.5	10.3	Ms	4104.5	8.6	Mx
	4084.6	9.2	Jo	4104.5	8.6	Ms
	4085.8	10.0	Lv	4104.6	8.4	B
	4086.5	9.6	Ms	4104.6	8.5	Ly
	4086.6	9.7	Ly	4104.6	8.4	Jo
	4086.6	10.0	Pt	4108.6	8.0	Ly
	4087.6	9.4	Ms	4108.6	8.4	Ks
	4088.6	9.4	Al			
021143a W ANDROMEDAE—						
	4047.6	11.5	Ie	4086.6	10.9	Pt
	4053.6	11.8	Pt	4093.6	8.4	Ie
	4056.9	11.2	Br	4093.6	8.8	B
	4067.6	10.7	Ie	4104.6	7.5	B
021258 T PERSEI—						
	4053.6	8.3	Pt	4063.2	8.8	Ch
021281 Z CEPHEI—						
	4053.6	11.5	Pt	4086.6	13.0	Pt
	4056.7	11.5	Wf	4088.7	[11.5	Mz
	4060.5	11.6	Ie	4091.6	13.3	B
	4064.8	11.8	Wf	4104.6	[13.6	B
	4085.6	13.3	Ie			
021403 o CETI—						
	4036.1	8.2	Kk	4081.7	8.8	Gb
	4051.1	9.1	Kk	4082.8	9.0	Cy
	4051.6	8.9	Ks	4082.8	8.5	Cy

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER AND NOVEMBER, 1924.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
021403 o CETI—Continued.						
	4052.7	9.2	Cy	4084.6	8.4	I
	4053.6	9.1	Pt	4084.7	8.8	Ms
	4054.7	9.1	Cy	4084.7	8.7	Hy
	4054.7	9.2	Hy	4084.7	8.7	Cy
	4056.2	9.3	Ch	4084 7	8.8	Cy
	4056.2	9.8	Kk	4086.6	8.6	Pt
	4056.5	7.3	Ms	4087.6	8.8	Ms
	4056.6	7.3	Ms	4088.3	9.1	An
	4058.4	9.3	An	4088.6	8.7	Ms
	4061.7	9.1	Ca	4090.6	8.7	Ks
	4062.8	9.3	Cy	4091.6	8.5	Mx
	4064.4	8.7	L	4091.7	8.4	Ms
	4064.6	8.7	Ks	4091.8	8.6	Cy
	4066.2	9.0	Ch	4093.6	8.0	Ms
	4068.4	8.9	Ch	4094.6	8.2	I
	4076.6	8.0	Hu	4094.7	8.6	Cy
	4076.7	8.8	Hy	4107.6	7.0	Hu
	4076.7	9.0	Cy	4107.6	7.3	Hb
	4077.3	9.3	An	4108.5	7.2	Mx
	4078.6	8.0	I	4108.6	7.1	Ks
021558 S PERSEI—						
	4004.	9.1	Kl	4072.6	9.1	Ks
	4017.	9.2	Kl	4076.6	8.4	Hu
	4026.	9.3	Kl	4086.6	8.5	Pt
	4034.	9.4	Kl	4086.6	8.7	Pt
	4053.6	8.6	Pt	4091.6	9.1	B
	4062.2	9.3	Ch			
022000 R CETI—						
	4053.7	8.5	Ca	4062.2	8.6	Ch
	4060.8	8.6	Mz	4063.8	8.4	Br
	4061.7	8.6	Ca	4088.7	10.5	Mz
	4063.7	8.7	Mz			
022150 RR PERSEI—						
	4053.6	13.6	Pt	4077.8	[13.5	Br
	4054.7	14.0	Ie	4082.6	[13.5	Ie
	4056.7	13.6	Wf	4091.6	[13.8	B
	4056.9	14.2	Br	4104.5	[13.5	B
	4064.8	14.5	Wf			
022813 U CETI—						
	4050.1	7.4	Kk	4062.2	7.1	Ch
	4053 6	7.5	Ca	4086.6	7.1	Pt
	4056.2	7.3	Kk	4089 6	7.6	Y
	4058.2	7.1	Kk	4094.7	7.2	Hb
	4059.7	7.1	Pt	4117.6	7.5	Hb
	4061.7	7.4	Ca			
022980 RR CEPHEI—						
	4053.6	10.5	Pt	4064.8	10.6	Wf
	4056.7	10.9	Wf	4080.8	11.0	Pa
	4060.5	11.0	Ie	4086.6	11.6	Pt
	4063.8	10.5	Br	4108.8	12.4	Pa
022424 R FORNACIS—						
	3994.3	11.3	Bl	4017.1	9.5	Bl
	4003.1	10.9	Bl	4058.1	8.5	Bl
023133 R TRIANGULI—						
	4047.7	10.3	Ie	4082 6	9.2	Cu
	4050.9	7.6	Kk	4084.6	9.2	Mz
	4055.7	9.2	Cy	4085.8	8.8	Lv
	4056 2	7.5	Kk	4086.6	8.7	Pt
	4061.7	9.7	Mz	4090.6	8.5	Ks
023133 R TRIANGULI—Continued.						
	4068.6	9.5	Mz	4093.6	8.3	B
	4069.6	9.2	Ie	4093.6	8.8	Mz
	4076.6	8.9	Pt	4093.6	8.3	Ie
	4076.7	9.2	Cy	4104.6	9.2	B
	4076.7	9.0	Hy			
024356 W PERSEI—						
	4001.1	9.1	Nk	4056.0	9.7	Nk
	4001.2	9.0	Nk	4061.6	9.2	Hu
	4005.1	9.1	Nk	4061.6	9.6	Ca
	4007.2	9.0	Nk	4063.6	10.1	Mz
	4025.1	10.1	Mj	4072.6	9.3	Ks
	4036.1	9.2	Nk	4076.7	9.5	Cy
	4036.1	10.1	Mj	4076.7	9 5	Hy
	4048.1	9.8	Nk	4086.6	9.4	Pt
	4048.2	10.1	Mj	4091.7	9.9	Mz
	4051.2	9.3	Mj	4091.8	9.5	Cy
	4053.6	9.4	Pt	4103.6	9.6	Ms
	4055 6	9.3	Cy	4107.6	9.2	Hu
025050 R HOROLOGII—						
	3994.1	11.4	Bl	4017.1	9.8	Bl
	4003.1	10.1	Bl	4058.1	6.0	Bl
025751 T HOROLOGII—						
	3994.1	11.5	Bl	4058.1	13.1	Bl
	4003.1	12.1	Bl			
030514 U ARIETIS—						
	4056.9	13.5	Br	4087.8	14.0	Pa
	4077.8	13 6	Br	4108.8	14.1	Pa
	4083.8	13.9	Pa			
031401 X CETI—						
	4051.7	12.0	Pt	4064.7	12.3	Ks
	4055.7	12.0	Ca	4064.4	12.6	L
	4056.7	12.0	Wf	4064.8	12.1	Wf
	4056.9	11.9	Br	4077.8	12.2	Br
	4059.7	12.0	Pt	4086.6	12.5	Pt
	4063.8	12.0	Br			
032043 Y PERSEI—						
	4001.2	9.1	Nk	4061.6	8.5	Hu
	4048.1	8.3	Nk	4086.6	8.9	Pt
	4056.0	9.1	Nk	4093.6	9.7	B
	4059.7	8.2	Pt	4107.6	9.5	Hu
032335 R PERSEI—						
	4056.9	14 0	Br	4090.6	12.2	Ks
	4077.8	13.0	Br	4096.6	12.0	B
	4082.6	12.5	Ie	4107.6	10.5	Hu
032443 NOVA PERSEI #3—						
	4048.1	14.3	Nk	4056.0	13.3	Nk
042209 R TAURI—						
	4060.7	12.8	Ie	4087.8	13.7	Pa
	4083.8	13.5	Pa			
042215 W TAURI—						
	4052 7	9.6	Cy	4086.6	9.4	Pt
	4059.7	8.9	Pt	4088.7	9.9	Mz
	4062.8	9.4	Cy	4090.6	9 9	Ks
	4064.7	9.9	Ks	4093.7	9.9	Cu
	4065.8	9.7	Mz	4094.8	9.8	Cy
	4068.8	9.0	Sg	4096.7	9 4	B
	4082.7	9.9	Cu	4105.7	10.3	Sg
	4082 8	9.8	Cy	4107.6	9.4	Hu
	4083.8	9.4	Sg			

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
042309 S TAURI—						
	4059.7	13.6	Pt	4087.8	14.4	Pa
043065 T CAMELOPARDALIS—						
	4046.6	9.3	L	4065.9	10.7	Mz
	4059.7	10.0	Pt	4075.6	10.7	L
	4064.4	10.6	L			
043208 RX TAURI—						
	4057.0	13.6	Br	4096.7	13.0	B
043263 R RETICULI—						
	3972.9	11.7	Bl	4058.1	12.2	Bl
	3994.1	12.5	Bl			
043274 X CAMELOPARDALIS—						
	4056.6	10.3	Ie	4086.6	8.0	Pt
	4059.7	10.2	Pt	4091.6	8.1	Mz
	4063.8	9.5	Br	4096.7	8.0	B
	4084.6	8.0	Ie			
043562 R DORADUS—						
	3992.9	5.4	Bl	4003.1	5.2	Bl
	3980.9	5.4	Bl	4017.1	6.0	Bl
	3994.1	5.5	Bl	4058.1	6.0	Bl
043738 R CAELI—						
	3994.3	11.3	Bl	4058.1	12.4	Bl
	4017.1	11.6	Bl			
044349 R PICTORIS—						
	3972.2	8.6	Bl	4017.1	7.8	Bl
	3994.3	8.6	Bl	4058.1	7.2	Bl
	4003.1	8.6	Bl			
044617 V TAURI—						
	4059.7	9.2	Pt	4086.6	9.6	Pt
	4060.7	9.3	Ie	4096.7	9.9	B
	4084.6	9.7	Ie			
045307 R ORIONIS—						
	4063.9	10.0	Br	4091.6	10.6	Ie
045514 R LEPORIS—						
	4037.2	9.2	Kk	4059.7	7.5	Pt
	4051.2	8.9	Kk	4064.4	8.6	Ch
	4051.7	8.3	L	4086.6	7.1	Pt
	4056.2	8.8	Kk	4087.7	7.5	Ms
	4058.3	8.7	Kk			
045516 R LEPORIS—						
	4065.7	7.8	L			
050003 V ORIONIS—						
	4057.0	13.0	Br	4086.6	11.4	Pt
	4060.8	12.5	Pt	4091.6	12.1	Ie
050022 T LEPORIS—						
	4058.1	11.5	Bl	4086.6	11.3	Pt
	4060.8	11.4	Pt			
050848 S PICTORIS—						
	4058.1	8.3	Bl			
050953 R AURIGAE—						
	4057.0	13.5	Br	4084.6	13.3	Ie
	4060.6	13.1	Ie	4086.6	13.4	Pt
	4059.7	13.4	Pt			
051247 T PICTORIS—						
	3994.3	9.9	Bl	4058.1	8.3	Bl
	4017.1	8.4	Bl			
051533 T COLUMBAE—						
	4058.1	9.2	Bl			
052036 W AURIGAE—						
	4059.7	8.4	Pt	4086.6	8.1	Pt
	4064.7	9.0	Ks	4108.6	8.9	Ks
	4076.8	9.0	Sg			
052036 W AURIGAE—						
	4052.7	12.2	Ie	4059.7	13.1	Pt
	4057.0	12.4	Br	4086.6	13.2	Pt
052404 S ORIONIS—						
	4057.0	10.8	Br	4061.7	10.3	Ca
	4059.7	10.0	Pt	4084.8	9.8	Pt
053005a T ORIONIS—						
	4040.6	10.3	L	4083.7	10.3	Pt
	4051.6	10.1	L	4084.8	10.5	Pt
	4053.6	10.1	L	4085.7	10.4	Pt
	4060.8	9.9	Pt	4087.7	10.6	Pt
	4065.6	10.1	L	4089.8	10.5	Pt
	4068.9	10.1	Pt	4090.8	10.5	Pt
	4070.7	10.2	Pt	4091.7	10.4	Pt
	4071.7	10.2	Pt	4092.7	10.5	Pt
	4073.8	10.2	Pt	4093.9	10.4	Pt
	4075.6	10.1	L	4099.7	10.2	Pt
	4082.8	[11.4	Sg	4106.7	10.1	Pt
053068 S CAMELOPARDALIS—						
	4059.7	8.4	Pt	4091.6	8.7	Mz
	4082.6	8.8	Pt			
053337 RU AURIGAE—						
	4057.0	14.5	Br	4076.8	11.2	Sg
053531 U AURIGAE—						
	4052.7	9.1	Ie	4082.6	9.9	Pt
	4059.7	8.8	Pt	4100.6	10.9	Ie
	4064.7	9.4	Ks	4103.6	10.3	B
	4078.6	10.2	Ie			
054319 SU TAURI—						
	4040.6	11.9	L	4082.6	[13.5	Pt
	4043.9	12.6	Wf	4084.5	[12.1	Y
	4054.8	13.8	Wf	4087.7	[12.1	Pt
	4056.9	13.6	Wf	4089.6	[12.6	Ie
	4057.9	14.5	Wf	4090.8	[13.5	Pt
	4059.7	13.7	Pt	4091.7	[12.1	Pt
	4060.8	13.8	Pt	4092.7	[13.5	Pt
	4064.8	14.5	Wf	4093.9	[11.5	Pt
	4065.6	13.6	L	4106.7	[12.1	Pt
	4068.9	14.6	Pt	4108.6	[11.5	Pt
	4075.7	[12.3	Wf			
054331 S COLUMBAE—						
	3994.3	11.1	Bl	4058.1	12.8	Bl
054615a Z TAURI—						
	4063.9	13.7	Br	4084.7	12.6	Ie
054615c RU TAURI—						
	4063.9	14.2	Br	4084.7	[13.1	Ie
054629 R COLUMBAE—						
	3994.3	10.3	Bl	4058.1	12.3	Bl
054920a U ORIONIS—						
	4021.2	5.7	Kk	4055.7	5.6	Ca
	4023.2	5.6	Kk	4055.8	6.2	Cy
	4025.2	5.6	Kk	4056.2	6.2	Kk
	4026.2	5.6	Kk	4057.8	5.9	Gb
	4027.2	5.7	Kk	4058.2	6.4	Kk
	4028.2	5.6	Kk	4060.8	6.0	Pt
	4030.2	5.7	Kk	4061.7	6.0	Ca

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
054920a U ORIONIS—Continued.						
	4031.2	5.7	Kk	4062.8	6.0	Cy
	4035.2	5.7	Kk	4079.7	6.4	Gb
	4036.1	5.7	Kk	4082.6	6.1	Pt
	4037.2	5.7	Kk	4082.8	6.7	Cy
	4039.2	5.8	Kk	4083.7	6.7	Cu
	4046.1	5.8	Kk	4083.7	6.6	Cu
	4048.2	5.7	Kk	4084.7	7.0	Cy
	4050.7	5.2	Ca	4084.7	7.0	Hy
	4051.1	5.8	Kk	4089.8	7.0	Gb
	4054.1	5.7	Kk	4107.6	8.5	Hu
	4054.9	6.0	Al			
054920b UW ORIONIS—						
	4062.8	10.8	Cy	4084.7	10.7	Hy
	4082.8	10.6	Cy	4091.7	10.8	Cy
	4084.7	10.7	Cy	4094.7	10.7	Cy
054974 V CAMELOPARDALIS—						
	4054.8	11.6	Pa	4083 8	12.3	Pa
	4060.6	11.6	Ie	4085.6	12.4	Ie
	4060.8	11.6	Pt	4089.6	12.1	Y
	4063.9	11.5	Br	4108.8	12 6	Pa
	4082.6	12.0	Pt			
055353 Z AURIGAE—						
	4056.7	10.8	Wf	4082.6	10.7	Pt
	4060.8	10.6	Pt	4109.6	10.5	Ks
	4064.8	10.8	Wf			
055686 R OCTANTIS—						
	3972.9	12.2	Bl	4058.1	11.3	Bl
	4016.9	12.1	Bl			
060450 X AURIGAE—						
	4060.6	9.6	Ie	4083.7	9.3	Cu
	4060.8	9.3	Pt	4084.6	8.6	Ie
	4073.6	8.7	Cu	4109.6	8.3	Ks
	4082.6	8.3	Pt			
061702 V MONOCEROTIS—						
	4060.8	12.6	Pt	4084.8	12.0	Pt
	4063.9	12.5	Br			
063159 U LYNCIS—						
	4089.6	[13.1	Y			
063308 R MONOCEROTIS—						
	4060.8	10.5	Pt	4084.8	10.6	Pt
063558 S LYNCIS—						
	4060.8	13.8	Pt	4084.8	13.1	Pt
	4063.9	13.6	Br	4091.7	12.3	Mz
064030 X GEMINORUM—						
	4057.0	12.0	Br	4091.6	13.6	Ie
064707 W MONOCEROTIS—						
	4060.8	10.2	Pt	4084.8	10.0	Pt
065111 Y MONOCEROTIS—						
	4060.8	10.5	Pt	4065.4	9.6	Ch
	4063.9	10.6	Br	4084.8	11.1	Pt
	4065.4	9.9	Ch			
065208 X MONOCEROTIS—						
	4051.7	8.3	L	4066.7	7.6	L
065355 R LYNCIS—						
	4060.8	9.7	Pt	4089.6	11.2	Y
	4084.8	10.8	Pt	4091.6	11.0	Ie
070109 V CANIS MINORIS—						
	4064.0	8.5	Br	4065.5	9.0	Ch
070122a R GEMINORUM—						
	4053.8	8.5	Ca	4084.8	6.4	Pt
	4060.8	7.4	Pt	4091.7	6.9	Mz
	4061.7	7.8	Ca	4091.7	7.0	Ie
	4063.9	7.5	Br	4094.7	7.3	Hb
	4083.7	6.8	Cu	4107.6	6.8	Hb
070122b Z GEMINORUM—						
	4060.8	12.5	Pt	4084.8	12.6	Pt
070122c TW GEMINORUM—						
	4053.8	8.2	Ca	4083.7	8.3	Cu
	4060.8	7.9	Pt	4084.8	7.7	Pt
	4061.7	8.1	Ca			
070310 R CANIS MINORIS—						
	4040.7	8.2	L	4066.7	8.2	L
	4055.7	8.1	L			
071201 RR MONOCEROTIS—						
	4064.0	12.7	Br			
071713 V GEMINORUM—						
	4060.8	10.4	Pt	4084.8	11.5	Pt
	4064.0	11.0	Br			
072708 S CANIS MINORIS—						
	4051.6	12.7	L	4065.7	12.6	L
	4060.8	12.4	Pt	4084.8	12.3	Pt
	4064.0	12.8	Br			
072811 T CANIS MINORIS—						
	4060.8	10.4	Pt	4084.8	11.7	Pt
	4064.0	11.0	Br			
072820b Z PUPPIS—						
	4064.0	[13.0	Br			
073173 S VOLANTIS—						
	3988.9	[12.8	Bl	4058.1	11.7	Bl
	4016.9	13.2	Bl			
073508 U CANIS MINORIS—						
	4051.6	12.9	L	4065.7	12.8	L
	4060.8	12.6	Pt	4084.8	11.6	Pt
	4064.0	12.8	Br			
073723 S GEMINORUM—						
	4063.9	13.4	Br	4091.7	12.4	Ie
074241 W PUPPIS—						
	3972.9	10.2	Bl	3988.9	9.0	Bl
	3980.9	9.1	Bl	4038.1	12.6	Bl
074323 T GEMINORUM—						
	4064.0	12.7	Br			
074922 U GEMINORUM—						
	4038.4	[9.3	Ch	4064.8	13.9	Wf
	4040.6	[12.9	L	4066 4	[12.4	Ch
	4047.6	[13.3	L	4068.9	14.5	Pt
	4048.9	[12.4	Du	4069.9	[13.7	Pt
	4049.9	[12.6	Du	4073.8	[10.0	Pt
	4051.6	[13.7	L	4075.6	13.8	L
	4053.8	[12 4	Ca	4082.7	[12.4	Cy
	4054.8	13.7	Wf	4083.8	[11.4	Cu
	4055.6	14.0	L	4084.8	[13.3	Pt
	4056.9	13.8	Wf	4087.7	[12.4	Pt
	4057.0	13.9	Br	4088.7	[11.4	Cu
	4057.9	13.9	Wf	4089 8	[11.7	Pt
	4060.8	14.0	Pt	4090.8	[13.3	Pt
	4062.4	[12.4	Ch	4091.7	[13.3	Pt
	4063.0	14.0	Br	4091.7	[12.4	Cy
	4064.6	13.7	L	4093.9	[12.4	Pt

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
075612 U PUPPIS—						
	4064.4	[10.8	Ch			
081112 R CANCRI—						
	4055.7	11.3	L	4091.8	11.3	Cy
	4060.8	11.2	Pt	4091.9	10.4	Pt
	4066.7	11.4	L			
081617 V CANCRI—						
	4060.8	13.2	Pt	4091.9	10.9	Pt
082405 RT HYDRAE—						
	4091.9	8.0	Pt			
082476 R CHAMAELEONTIS—						
	3972.1	8.5	Bl	4009.9	9.2	Bl
	3980.9	8.5	Bl	4016.9	9.7	Bl
	3988.9	8.6	Bl	4056.9	11.7	Bl
	4001.9	8.7	Bl			
083019 U CANCRI—						
	4056.9	14.0	Wf			
083350 X URSAE MAJORIS—						
	4060.8	11.1	Pt	4091.9	12.5	Pt
084803 S HYDRAE—						
	4060.8	11.2	Pt	4091.9	11.0	Pt
085008 T HYDRAE—						
	4055.7	7.6	L	4066.7	7.4	L
	4063.4	9.5	Ch	4091.9	8.0	Pt
085120 T CANCRI—						
	4060.8	8.2	Pt	4091.9	9.8	Pt
	4063.4	9.5	Ch			
090024 S PYXIDIS—						
	4091.9	12.8	Pt			
090425 W CANCRI—						
	4056.9	14.2	Wf	4091.8	12.6	Cy
091868 RW CARINAE—						
	3972.1	9.5	Bl	4009.9	10.5	Bl
	3980.9	9.6	Bl	4016.9	11.1	Bl
	3988.9	9.6	Bl	4056.9	12.7	Bl
	4001.9	10.2	Bl			
092551 Y VELORUM—						
	3972.9	11.1	Bl	4001.9	12.3	Bl
	3980.9	11.6	Bl	4016.9	12.5	Bl
	3988.9	11.8	Bl	4058.1	[12.4	Bl
092962 R CARINAE—						
	3972.1	9.1	Bl	4009.9	8.4	Bl
	3980.9	9.0	Bl	4016.9	8.0	Bl
	3988.9	9.2	Bl	4036.9	6.9	Bl
	4001.9	8.6	Bl			
093014 X HYDRAE—						
	4063.5	[11.0	Ch	4091.9	12.9	Pt
093178 Y DRACONIS—						
	4071.7	13.8	Br	4091.6	13.4	Ie
093934 R LEONIS MINORIS—						
	4060.8	12.5	Pt	4091.9	12.5	Pt
094211 R LEONIS—						
	3911.5	8.3	Gd	4091.8	10.3	Cy
	4058.4	9.5	Ch	4091.9	9.5	Pt
	4060.8	8.8	Pt			
094622 Y HYDRAE—						
	4091.9	6.4	Pt			
094953 Z VELORUM—						
	3988.9	[12.8	Bl	4058.1	11.8	Bl
	4016.9	12.7	Bl			
095421 V LEONIS—						
	4057.0	12.9	Wf	4091.8	11.0	Cy
	4060.8	12.5	Pt	4091.9	10.3	Pt
	4063.5	11.9	Ch			
095563 RV CARINAE—						
	3988.9	[13.1	Bl	4056.9	[13.1	Bl
	4016.9	[13.1	Bl			
100661 S CARINAE—						
	3972.1	6.8	Bl	4009.9	6.0	Bl
	3980.9	6.9	Bl	4016.9	5 9	Bl
	3988.9	6.9	Bl	4056.9	8.0	Bl
	4001.9	6 3	Bl			
101058 Z CARINAE—						
	3988.9	[12.3	Bl	4057.9	10.9	Bl
	4016.9	[12.6	Bl			
101153 W VELORUM—						
	3972.9	12.8	Bl	4001.9	12.4	Bl
	3980 9	12.5	Bl	4016.9	10.2	Bl
	3988.9	12.7	Bl			
103212 U HYDRAE—						
	4084.3	6.0	Kd			
103769 R URSAE MAJORIS—						
	3986 6	11.0	Cu	4077.6	11.8	Br
	4052.5	12.5	Ie	4081.6	11.7	Ie
	4055.7	12.3	Br	4082.8	11.7	Cy
	4060.8	12.3	Pt	4091.9	11.1	Pt
	4075.6	11.8	Wf			
104620 V HYDRAE—						
	3972.9	10.6	Bl	4009.9	10.0	Bl
	3980.9	9.9	Bl	4016.9	10.6	Bl
	3988.9	10.9	Bl	4091.9	10.6	Pt
	4001.9	10.6	Bl			
104628 RS HYDRAE—						
	3972 9	11.4	Bl	4001.9	10.1	Bl
	3980.9	10.9	Bl	4009.9	9.5	Bl
	3988.9	10.8	Bl	4016.9	10.2	Bl
110506 S LEONIS—						
	4091.9	11.6	Pt			
111561 RY CARINAE—						
	4056.9	12.5	Bl			
111661 RS CENTAURI—						
	3988.9	13.5	Bl	4016.9	9.8	Bl
	4001.9	12.5	Bl	4056.9	8.3	Bl
	4009.9	11.8	Bl			
114441 X CENTAURI—						
	3972.9	10.7	Bl	4001.9	7.8	Bl
	3980.9	10.0	Bl	4009.9	7.2	Bl
	3988.9	9.4	Bl	4016.9	7.7	Bl
115058 W CENTAURI—						
	3988.9	12.3	Bl	4016.9	11.7	Bl
	4001.9	11.7	Bl	4056.9	8.6	Bl
	4009.9	11.4	Bl			
120012 SU VIRGINIS—						
	4002.5	11.4	Gd	4091.9	12.4	Pt
122532 T CANUM VENATICORUM—						
	4091.9	9.5	Pt			
122854 U CENTAURI—						
	4016.9	12.6	Bl	4056.0	9.3	Bl

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Star	J.D.	Est.Obs.	J.D.	Est.Obs.
123160 T URSAE MAJORIS—				
	3986.6	[12.4 Cu	4068.5	8.5 Mz
	4033.5	11.0 Ya	4072.5	8.6 Ca
	4034.	10.4 Kl	4072.5	8.7 Ie
	4036.	10.4 Kl	4072.6	8.4 Ks
	4051.6	9.1 Pt	4074.5	8.4 Ly
	4052.5	8.7 Ie	4075.6	8.4 Wf
	4053.5	9.0 Ly	4077.7	8.5 Sg
	4060.6	8.8 Mz	4081.5	8.3 Pt
	4061.5	8.4 Ca	4082.5	8.3 Cu
	4061.5	8.9 Ly	4088.5	8.5 Ly
123307 R VIRGINIS—				
	4091.9	6.4 Pt		
123459 RS URSAE MAJORIS—.				
	3986.6	9.1 Cu	4054.9	13.6 Lv
	4020.6	11.1 Lv	4055.6	13.0 Wf
	4024.5	11.0 Ya	4064.6	13.4 Wf
	4024.7	11.0 Mz	4075.6	14.0 Wf
	4051.6	13.2 Pt	4081.5	13.5 Pt
	4052.5	13.0 Ie	4082.5	12.6 Ie
	4054.9	13.6 Lv	4091.8	13.2 Cy
123961 S URSAE MAJORIS—				
	3986.6	8.5 Cu	4061.5	8.4 Ca
	4004.	8.4 Kl	4061.5	8.5 Ly
	4006.	8.4 Kl	4063.5	8.2 Mz
	4015.	8.4 Kl	4067.2	9.0 An
	4017.	8.3 Kl	4068.5	8.7 Mz
	4020.7	8 4 Lv	4072.5	8.4 Ca
	4023.	8.3 Kl	4072.5	8.7 Cu
	4024.5	8.6 Ya	4072.6	8.6 Ks
	4024.7	7.5 Sg	4074.2	9.1 An
	4026.	8.3 Kl	4074.5	8.6 Ly
	4027.6	8.6 Cg	4076.3	8.3 L
	4030.8	7.9 Bi	4075.6	8.9 Wf
	4032.	8.5 Kl	4077.7	8.6 Sg
	4034.	8.3 Kl	4081.5	8.9 Lv
	4034.3	8.9 An	4081.5	8.6 Pt
	4036.	8.2 Kl	4081.5	8.6 Bi
	4044.3	8.0 An	4082.5	9.2 Cu
	4048.3	7.9 L	4082 8	8.4 Cy
	4051.6	8.1 Pt	4084.6	8.2 Mh
	4053.5	8.2 Ly	4084.6	8.8 Mh
	4054.6	7.8 Bi	4088.5	8 0 Ly
	4054.7	8.3 Lv	4090.5	8.9 Bi
	4058.3	8.3 An	4104.5	9.3 Bi
	4060.6	8.3 Mz		
124204 RU VIRGINIS—				
	3911.6	12.6 Gd		
124606 U VIRGINIS—				
	4091.9	8.5 Pt		
131283 U OCTANTIS—				
	3972.1	10.3 Bl	4001.9	8.5 Bl
	3980.9	9.8 Bl	4015.9	8.2 Bl
	3988.9	9.8 Bl	4052.9	8.4 Bl
132422 R HYDRAE—				
	3972.1	7.4 Bl	4009.9	8.1 Bl
	3981.0	7.2 Bl	4016.9	8.4 Bl
	3991.0	7 9 Bl	4052.9	8.7 Bl
	4003.0	8.0 Bl		
133155 RV CENTAURI—				
	3972.1	8.0 Bl	4003 0	7.2 Bl
	3980.9	7.8 Bl	4015.9	7.5 Bl
	3988.9	7.9 Bl	4052.9	7.5 Bl
133273 T URSAE MINORIS—				
	4020.7	13.6 Lv	4077.6	14.5 Wf
	4055.6	14.0 Wf	4080.5	[13.7 Lv
	4064.6	14.1 Wf		
133633 T CENTAURI—				
	3972.1	6.2 Bl	4009.9	7.8 Bl
	3981.0	6 3 Bl	4016.9	7.8 Bl
	3991.0	7.0 Bl	4053.9	6.0 Bl
	4003.0	7.7 Bl		
134236 RT CENTAURI—				
	3972.1	9.7 Bl	4009.9	10.9 Bl
	3981.0	9.9 Bl	4016.9	11.9 Bl
	3991.0	10.1 Bl	4052.9	12.4 Bl
	4003.0	10.3 Bl		
134440 R CANUM VENATICORUM—				
	3986.6	12.0 Cu	4061.5	9.3 Mz
	4017.6	11.6 Lv	4068.5	9.1 Mz
	4024 6	10.6 Ya	4073.5	9.3 Cu
	4051.6	9 3 Pt	4081.5	8.5 Pt
	4060.5	8.7 Ie	4084.5	8.7 Ie
134536 RX CENTAURI—				
	3872.1	[13.1 Bl	4009.9	10.8 Bl
	3991.0	12.5 Bl	4016.9	10.4 Bl
	4003.0	11 6 Bl	4052.6	9.3 Bl
134677 T APODIS—				
	3991 C	[13.2 Bl	4056.9	13.1 Bl
	4016.9	[13.2 Bl		
140113 Z BOOTIS—				
	4056.6	13.7 Wf		
140528 RU HYDRAE—				
	3972.1	11.4 Bl	4016.9	12.9 Bl
	3991.0	12.3 Bl	4056.9	[12.9 Bl
140959 R CENTAURI—				
	3972.1	10.5 Bl	4003.0	8.2 Bl
	3976.0	10 3 Bl	4012.0	7.5 Bl
	3980.9	9.9 Bl	4052.9	5.8 Bl
	3991.0	9.6 Bl		
141567 U URSAE MINORIS—				
	3986.6	12.4 Cu	4075.6	10.4 Lv
	4014.7	12.1 Lv	4078.6	10 5 Cu
	4030.8	11.8 Bi	4080.6	10.3 Lv
	4047.1	10.9 Ch	4081.5	10.5 Pt
	4051.6	10.9 Pt	4089.5	10.0 Mz
	4052.5	10.9 Mz	4090.5	9.5 Bi
	4059.6	11.1 Lv	4090.6	9.8 Ks
	4061.5	10.8 Mz	4090.6	10.1 Lv
	4062.6	10.9 Wl	4104.5	9.4 Bi
141954 S BOOTIS—				
	4001.7	11.0 Sg	4068.6	9.3 Mz
	4048 3	10.9 L	4072.6	8.9 Cu
	4051.6	10.2 Pt	4075.6	8.6 Wf
	4052.6	10.4 Cy	4077.7	8.9 Sg
	4052 6	10.2 Mz	4079.3	8.9 L
	4061.5	9.9 Mz	4070.3	8.9 L
	4061.6	9.3 Ks	4087.5	8.7 Mz
	4068.5	8.8 Ie	4090.5	8.8 Ie

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER AND NOVEMBER, 1924.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
142539 V BOOTIS—						
	3986.7	7.8	Cu	4053.5	11.1	Ca
	4024.7	9.5	Sg	4061.5	8.9	Mz
	4048.3	10.5	L	4068.5	9.0	Mz
	4048.6	10.7	Du	4070.3	10.9	L
	4051.6	10.9	Ks	4079.5	11.2	Pt
	4051.6	10.8	Pt	4087.5	9.0	Mz
	4052.6	11.0	Mz	4087.5	10.6	Cu
142584 R CAMELOPARDALIS—						
	4033.6	8.2	Ya	4070.6	9.4	Mz
	4052.6	8.8	Mz	4072.5	9.3	Cu
	4056.5	8.7	Ie	4075.6	9.2	Wf
	4061.6	9.0	Mz	4084.6	10.0	Ie
	4062.6	8.7	Ca	4090.6	10.4	Ks
	4062.6	9.2	Wl	4093.6	10.9	Mz
143227 R BOOTIS—						
	4051.6	12.6	Pt	4079.5	12.5	Pt
	4052.5	12.6	Ie			
145254 Y LUPI—						
	3972.1	12.3	Bl	4016.9	[13.7	Bl
	3991.0	13.4	Bl	4056.9	[13.7	Bl
145971 S APODIS—						
	3972.0	12.2	Bl	3991.0	11.0	Bl
	3976.0	11.7	Bl	4003.0	10.3	Bl
	3980.9	11.5	Bl	4012.1	10.3	Bl
	3985.0	11.4	Bl	4052.9	10.0	Bl
151714 S SERPENTIS—						
	4048.3	8.6	L	4070.5	9.5	Mz
	4051.6	8.8	Pt	4071.2	9.1	L
	4052.5	8.6	Ca	4072.5	9.6	Ca
	4056.6	8.9	Wf	4077.6	10.0	Wf
	4062.5	9.2	Mz	4079.5	9.4	Pt
	4064.6	9.1	Wf			
151731 S CORONAE BOREALIS—						
	4005.0	12.2	Nk	4081.5	9.6	Ms
	4006.0	12.4	Nk	4082.6	9.6	Ms
	4024.7	12.0	Sp	4083.6	9.0	Ms
	4051.6	11.2	Pt	4084.5	9.4	Mx
	4052.6	11.6	Cg	4084.5	9.4	Ms
	4053.5	12.0	Ca	4086.5	9.1	Ms
	4061.5	10.8	Mx	4087.5	8.8	Mz
	4062.5	10.8	Ms	4091.5	8.6	Cy
	4075.6	10.0	Wf	4091.5	9.0	Ms
	4075.6	11.0	Gb	4091.5	8.6	Mx
	4078.5	10.0	Ms	4093.5	8.4	Mz
	4078.5	10.0	Mx	4104.5	7.4	Ms
	4078.6	10.3	Sσ	4104.5	7.5	Gb
	4079.5	9.7	Pt	4104.5	7.4	Mx
151822 RS LIBRAE—						
	3972.1	11.3	Bl	4003.0	9.7	Bl
	3981.9	10.8	Bl	4012.1	9.3	Bl
	3991.0	10.3	Bl	4052.9	7.1	Bl
152849 R NORMAE—						
	3972.1	8.0	Bl	4003.0	10.2	Bl
	3980.9	9.1	Bl	4015.9	10.5	Bl
	3991.0	9.4	Bl	4052.9	11.8	Bl
153020 X LIBRAE—						
	3991.0	11.3	Bl	4016.0	11.2	Bl
	3993.9	11.2	Bl	4057.9	11.4	Bl
	4003.0	11.3	Bl			
153215 W LIBRAE—						
	3991.0	13.5	Bl	4057.9	10.7	Bl
	4016.9	13.1	Bl			
153378 S URSA MINORIS—						
	4005.0	10.7	Nk	4076.7	12.6	Hy
	4020.0	11.3	Nk	4077.3	10.8	Ro
	4051.6	11.8	Pt	4077.7	12.0	Sg
	4052.6	12.5	Mz	4078.6	12.2	Wf
	4052.7	12.7	Cy	4079.5	11.5	Pt
	4056.0	12.2	Nk	4082.7	12.7	Cy
	4062.7	12.8	Cy	4087.5	12.5	Mz
	4076.7	12.7	Cy	4090.6	12.1	Ks
153620a U LIBRAE—						
	3972.1	11.0	Bl	4003.0	13.1	Bl
	3991.0	11.9	Bl			
154020 Z LIBRAE—						
	3991.1	12.7	Bl			
154428 R CORONAE BOREALIS—						
	3993.7	6.0	Al	4069.5	8.7	Pt
	4000.0	6.1	Ks	4069.5	8.7	Ks
	4001.1	6.1	Ks	4069.6	9.0	Ly
	4002.1	6.0	Ks	4070.3	9.1	L
	4003.0	6.1	Ks	4070.5	9.0	Ly
	4004.0	6.1	Ks	4070.5	8.9	Ie
	4005.0	6.1	Ks	4070.6	9.0	Mz
	4007.0	6.2	Ks	4071.5	8.6	Pt
	4009.6	6.2	Ks	4071.5	9.0	Ly
	4010.1	6.1	Ks	4071.5	8.4	Cy
	4011.0	6.1	Ks	4071.5	8.6	Cu
	4012.0	6.0	Ks	4071.7	8.6	Sg
	4013.0	6.1	Ks	4072.5	8.9	Ca
	4014.0	6.1	Ks	4072.5	8.7	Pt
	4016.0	6.0	Ks	4072.5	8.7	Ie
	4016.7	6.2	Al	4072.5	8.6	Cu
	4017.6	6.0	Kr	4072.5	9.0	Ly
	4019.3	6.1	Sh	4072.5	8.6	Cy
	4021.4	6.2	Sh	4072.6	8.5	Ks
	4024.6	5.5	Cg	4072.7	9.0	Sg
	4024.7	6.0	Sg	4073.5	8.5	Pt
	4026.0	6.0	Kd	4073.5	8.6	Ly
	4029.9	6.0	Kd	4073.5	8.1	Ms
	4030.4	6.0	L	4073.5	8.7	Cu
	4032.7	6.0	Sg	4073.6	8.5	Gb
	4033.6	6.0	Ya	4073.7	8.9	Sg
	4036.0	6.0	Kd	4073.9	7.7	Kd
	4045.1	6.0	Ch	4074.5	8.5	Ly
	4045.3	6.2	An	4074.9	7.8	Kd
	4045.9	6.1	Kd	4075.5	8.5	Ie
	4047.3	6.2	An	4075.5	8.4	Pt
	4047.5	6.2	Ms	4075.6	8.7	Ks
	4047.5	6.0	Ie	4075.6	8.5	Br
	4047.5	6.0	Kr	4075.6	8.5	Gb
	4048.3	6.0	L	4075.6	8.2	My
	4048.6	6.3	Hy	4075.9	7.8	Kd
	4048.6	6.1	Du	4076.5	8.3	Pt
	4050.4	6.2	L	4076.5	8.3	Ly
	4050.6	6.0	Ca	4076.5	8.0	Y
	4050.9	6.0	Kd	4077.5	7.7	Mx
	4051.6	6.2	Pt	4077.5	8.0	Ly
	4051.7	6.0	Ks	4077.5	7.8	Ms

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
154428 R CORONAE BOREALIS—Continued.						
	4052.5	6.2	Ly	4077.6	7.7	Sg
	4052.6	6.2	Pt	4077.6	8.2	My
	4052.6	6.2	Ie	4078.5	8.0	Ly
	4052.6	6.4	Cy	4078.5	8.0	Ms
	4053.5	6.1	Ca	4078.5	7.8	Pt
	4053.5	6.4	Mx	4078.5	8.0	Mx
	4053.5	6.2	Ms	4078.5	8.0	Ie
	4053.6	6.2	Pt	4078.5	8.3	Cu
	4054.5	6.2	Ly	4078.6	8.8	Sg
	4054.5	6.5	Hy	4079.5	8.0	Ie
	4054.5	6.4	Cy	4079.5	8.1	Ms
	4054.6	6.2	Pt	4079.5	7.6	Pt
	4054.6	6.1	Ca	4081.5	8.2	Ms
	4054.6	6.1	Ks	4081.5	7.6	Pt
	4055.1	6.2	Ch	4081.5	8.0	Ie
	4055.5	6.5	Ms	4082.5	7.5	Ie
	4055.6	6.4	Wf	4082.5	7.3	Pt
	4055.6	6.2	Ca	4082.5	7.9	Cu
	4055.6	6.5	Ly	4082.5	8.2	Ms
	4055.6	6.2	Pt	4083.4	7.3	Cu
	4055.6	6.4	Cy	4083.5	7.5	Ie
	4055.6	6.0	Kr	4083.5	7.4	Pt
	4056.1	6.6	Ch	4083.5	8.0	Ms
	4056.5	6.5	Mx	4083.6	7.3	Mh
	4056.5	6.3	Ca	4084.5	7.4	Ie
	4056.5	6.5	Ms	4084.5	7.4	Mz
	4056.6	6.6	Cm	4084.5	7.8	Mx
	4056.6	6.6	Wf	4084.5	7.8	Ms
	4056.6	7.0	Hu	4084.9	6.6	Kd
	4057.5	6.5	Ms	4085.5	7.8	Ms
	4057.6	6.6	Wf	4085.5	7.3	Pt
	4058.3	6.7	An	4085.5	7.8	Kr
	4058.5	6.5	Mx	4086.5	7.7	Ms
	4058.5	6.5	Ms	4086.5	7.1	Ly
	4058.6	6.8	Wf	4087.5	7.1	Pt
	4059.3	6.9	An	4087.5	7.2	Mz
	4059.6	6.9	Mx	4087.5	7.8	Ms
	4060.5	6.5	Ie	4087.5	7.2	Cu
	4060.5	6.8	Ly	4088.4	7.1	Cu
	4060.5	7.0	Ms	4088.5	6.9	Ly
	4060.6	6.2	Pt	4088.5	6.9	Pt
	4061.5	7.1	Mx	4088.5	7.3	Ie
	4061.5	7.0	Ly	4088.5	7.2	Mz
	4061.5	6.5	Ie	4089.5	7.0	Gb
	4061.5	6.7	Pt	4089.5	7.6	Mx
	4061.5	7.1	Ms	4089.5	7.8	Kr
	4061.6	7.2	Mz	4089.5	6.9	Mz
	4061.6	7.0	Ca	4089.5	6.8	Pt
	4061.6	6.9	Ks	4089.6	6.5	Sg
	4062.5	7.4	Mz	4090.5	7.0	Y
	4062.5	7.0	Ly	4090.5	6.9	Mz
	4062.5	7.1	Ca	4090.5	6.9	Ks
	4062.5	7.3	Ms	4091.5	6.7	Ly
	4062.5	7.1	Pt	4091.5	7.1	Mx
	4062.6	7.3	Cu	4091.5	7.0	Ms
	4062.6	7.3	Cy	4091.5	6.9	Mz
	4063.5	7.2	Ly	4091.5	7.1	Cy
	4063.5	7.3	Mz	4091.5	6.7	Ie
	4064.4	7.5	L	4091.5	7.0	Cy
	4064.5	7.6	Ie	4092.5	6.6	Pt
	4064.5	7.2	Cu	4093.5	6.5	Ie
	4064.6	7.6	Wf	4093.5	6.0	Mz
	4064.6	7.6	Br	4093.5	6.5	Pt
	4064.6	7.9	Ks	4093.5	7.0	Ms
	4065.5	7.9	Pt	4094.5	6.5	Ly
	4065.5	8.1	Ly	4094.5	6.5	Pt
	4066.6	8.0	Br	4099.5	6.2	Pt
	4066.6	8.1	Ch	4100.5	6.5	Ly
	4067.5	8.2	Pt	4100.5	6.2	Ie
	4067.5	8.6	Ly	4102.5	6.8	Mx
	4067.5	8.7	Ie	4102.5	6.3	Pt
	4068.5	8.4	Pt	4102.6	6.2	Sg
	4068.5	8.4	Ie	4103.5	6.7	Ms
	4068.5	8.6	Ly	4104.5	6.5	Ms
	4068.6	9.0	Mz	4104.5	6.7	Mx
	4068.6	9.0	Br	4106.5	6.3	Pt
	4069.5	9.0	Ie	4107.5	6.2	Ly
154536 X CORONAE BOREALIS—						
	4048.5	12.0	Ie	4075.6	12.5	Wf
	4055.7	13.3	Wf	4078.5	12.3	Ie
	4064.7	12.9	Wf			
154615 R SERPENTIS—						
	4047.1	8.1	Ch	4075.6	7.5	Wf
	4051.6	13.3	Pt			
154639 V CORONAE BOREALIS—						
	4047.5	7.2	Ya	4062.5	7.0	Ca
	4051.6	6.9	Pt	4064.7	7.4	Wf
	4055.6	6.9	Ca	4072.5	7.0	Ca
	4055.7	7.6	Wf	4079.5	6.8	Pt
155018 RR LIBRAE—						
	4051.6	10.5	Pt			
155229 Z CORONAE BOREALIS—						
	4079.5	12.5	Ie	4091.5	11.7	Cy
155823 RZ SCORPII—						
	4051.6	12.4	Pt			
160021 Z SCORPII—						
	3972.2	12.3	Bl	4016.0	10.7	Bl
	3991.1	11.8	Bl	4052.9	10.6	Bl
	4003.0	11.0	Bl			
160118 R HERCULIS—						
	4079.5	12.2	Ie	4100.5	9.3	Ie
	4079.5	12.3	Pt			
160210 U SERPENTIS—						
	4005.0	8.8	Nk	4052.5	10.6	Ly
	4006.0	8.9	Nk	4053.5	10.5	Ca
	4015.0	8.9	Nk	4059.6	11.3	Mz
	4024.6	9.2	Ya	4060.5	11.3	Ly
	4048.6	9.8	Du	4079.5	12.0	Pt
	4051.6	10.2	Pt			
160221a X SCORPII—						
	3991.1	[12.5	Bl	4057.9	[13.0	Bl
	4016.9	[13.0	Bl			
160325 SX HERCULIS—						
	4048.3	7.8	L	4075.5	8.1	Pt
	4051.6	8.0	Pt	4075.6	8.7	Wf
	4052.6	7.8	Pt	4076.5	8.2	Pt
	4053.6	8.9	Pt	4078.5	8.4	Pt
	4054.6	8.0	Pt	4079.5	8.3	Pt

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Star	J.D.	Est.Obs.	J.D.	Est.Obs.
160325 SX HERCULIS—Continued.				
	4055.6	8.0 Pt	4081.5	8.2 Pt
	4055.7	8.0 Wf	4082.5	8.3 Pt
	4060.6	8.1 Pt	4083.5	8.6 Pt
	4061.5	8.2 Pt	4085.5	8.7 Pt
	4062.5	8.2 Pt	4087.5	8.7 Pt
	4064.7	8.1 Wf	4088.5	9.0 Pt
	4065.5	8.2 Pt	4089.5	9.1 Pt
	4067.5	8.2 Pt	4092.5	9.0 Pt
	4068.5	8.2 Pt	4093.5	9.2 Pt
	4069.5	8.1 Pt	4094.5	8.8 Pt
	4070.3	8.2 Wf	4099.5	8.9 Pt
	4071.5	8.2 Pt	4100.5	9.2 Pt
	4072.5	8.1 Pt	4102.5	9.2 Pt
	4073.5	8.1 Pt	4106.5	8.9 Pt
160519 W SCORPII—				
	3993.9	[13.0 Bl	4057.9	[13.0 Bl
	4016.9	[13.0 Bl		
160625 RU HERCULIS—				
	4024.6	10.5 Ya	4064.7	11.7 Wf
	4048.3	11.0 L	4075.6	12.0 Wf
	4049.6	11.6 Ie	4076.3	11.5 L
	4051.6	11.0 Pt	4078.5	12.3 Ie
	4055.7	11.5 Wf	4079.5	12.3 Pt
	4064.6	11.3 Ks		
161122a R SCORPII—				
	3993.9	[13.0 Bl	4057.9	[13.0 Bl
	4016.9	[13.2 Bl		
161122b S SCORPII—				
	3993.9	12.8 Bl	4051.6	11.6 Bl
	4003.0	12.7 Bl	4052.9	11.7 Bl
	4016.0	11.7 Bl	4057.9	11.9 Bl
161138 W CORONAE BOREALIS—				
	4052.6	[11.8 Ie	4079.5	12.8 Ie
	4075.6	12.8 Wf	4089.6	11.8 Y
161607 W OPHIUCHI—				
	4048.3	12.5 L	4053.5	[12.5 Ie
162112 V OPHIUCHI—				
	4051.6	9.4 Pt	4079.5	9.8 Pt
162119 U HERCULIS—				
	4004.0	9.5 Kl	4034.0	10.2 Kl
	4006.0	9.6 Kl	4047.5	10.0 Ie
	4007.0	9.6 Kl	4051.6	10.9 Pt
	4015.0	9.9 Kl	4052.6	10.4 Mz
	4017.0	9.7 Kl	4055.6	10.3 Ca
	4019.5	10.1 We	4056.6	10.6 Cm
	4023.0	10.4 Kl	4056.6	10.6 Hu
	4026.0	10.5 Kl	4062.5	10.8 Mz
	4026.5	9.5 We	4069.5	11.2 Ie
	4032.0	10.2 Kl	4086.5	11.3 B
	4032.7	9.1 Sg	4090.5	11.3 Mz
	4033.0	10.2 Kl	4093.5	11.5 Ie
	4033.6	10.0 Ya		
162807 SS HERCULIS—				
	4049.5	11.0 Ie	4070.5	9.2 Ie
	4051.6	10.5 Pt	4079.5	9.1 Pt
	4059.5	10.0 Mz	4087.5	10.1 Mz
	4063.6	9.7 Mz	4088.5	10.0 Mz
	4068.6	10.5 Pt	4091.5	9.1 Pt
	4070.3	9.4 L		
162815 T OPHIUCHI—				
	3972.2	11.9 Bl	4016.9	[13.1 Bl
	3993.9	12.7 Bl	4057.9	[12.8 Bl
162816 S OPHIUCHI—				
	3993.9	13.8 Bl	4052.9	9.8 Bl
	4003.0	13.2 Bl	4057.9	10.2 Bl
	4016.0	12.2 Bl		
163137 W HERCULIS—				
	4047.1	8.4 Ch	4068.5	9.3 Ie
	4051.6	8.4 Pt	4068.6	9.4 Mz
	4051.6	8.6 Mz	4079.5	9.8 Pt
	4052.6	8.4 Mz	4086.5	10.1 B
	4053.6	8.6 Ca	4087.6	10.4 Mz
	4056.6	8.9 Hu	4089.5	10.3 Ie
	4061.6	8.7 Ca	4105.5	11.1 B
	4062.6	9.1 Mz		
163266 R DRACONIS—				
	4000.5	11.9 We	4062.6	10.5 Ca
	4047.1	11.0 Ch	4075.5	9.9 B
	4050.7	10.8 Ca	4076.6	9.7 Jo
	4051.6	11.3 Pt	4078.6	9.7 Cu
	4051.7	10.9 Mz	4069.5	9.6 Pt
	4054.4	11.0 We	4081.7	9.5 Br
	4057.1	10.8 Ch	4089.5	9.0 Mz
	4061.4	10.8 We	4093.6	8.9 Mz
	4062.6	10.9 Wl	4100.5	7.8 B
	4062.6	10.9 Mz		
164715 S HERCULIS—				
	4000.0	8.4 Ks	4034.9	8.9 Kk
	4001.1	8.5 Ks	4038.9	9.0 Kk
	4002.1	8.5 Ks	4047.1	9.0 Ch
	4005.0	8.4 Ks	4051.6	9.2 Pt
	4006.9	8.4 Ks	4053.5	9.4 Ca
	4008.0	8.4 Ks	4059.5	9.5 Mz
	4010.2	8.2 Ks	4063.5	9.5 Mz
	4011.2	8.2 Ks	4068.5	9.6 Ie
	4012.1	8.2 Ks	4068.6	9.8 Mz
	4016.1	8.2 Ks	4079.5	9.9 Pt
	4020.9	8.4 Kk	4086.5	10.2 B
	4026.9	8.7 Kk	4087.5	10.6 Mz
	4030.9	8.7 Kk	4090.5	10.4 Ie
	4033.6	8.9 Ya		
164844 RS SCORPII—				
	3972.2	7.6 Bl	4003.0	9.0 Bl
	3981.9	8.4 Bl	4016.0	9.6 Bl
	3993.9	9.0 Bl	4053.0	10.4 Bl
165030 RR SCORPII—				
	3972.2	6.9 Bl	4003.0	8.5 Bl
	3981.9	7.5 Bl	4016.0	9.0 Bl
	3993.9	8.5 Bl	4052.9	11.4 Bl
165631 RV HERCULIS—				
	4000.0	10.2 Nk	4048.1	8.0 Nk
	4005.0	10.7 Nk	4051.6	12.6 Pt
	4006.0	10.9 Nk	4052.7	12.0 Bi
	4014.7	10.9 Lv	4053.6	13.0 Bi
	4015.0	11.0 Nk	4053.6	12.8 Lv
	4017.7	10.8 Lv	4056.0	8.5 Nk
	4032.7	11.7 Sg	4074.6	13.7 Lv
	4034.9	11.6 Bi	4079.5	14.2 Pt
	4036.0	12.9 Nk	4090.6	13.9 Lv

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Star	J.D.	Est.Obs.	J.D.	Est.Obs.
165636 RT SCORPII—				
	3981.9	8.8 Bl	4016.0	7.6 Bl
	3993.9	8.3 Bl	4053.0	8.7 Bl
	4003.0	7.9 Bl		
170215 R OPHIUCHI—				
	3961.0	7.8 Ik	4005.0	8.0 Ik
	3964.0	7.6 Ik	4005.1	8.0 Ik
	3971.0	7.4 Ik	4006.0	8.0 Ik
	3972.0	7.4 Ik	4007.0	8.0 Ik
	3973.0	7.4 Ik	4007.9	8.0 Ks
	3974.0	7.5 Ik	4010.0	8.1 Ik
	3975.0	7.5 Ik	4010.6	8.0 Ks
	3976.0	7.5 Ik	4012.0	8.1 Ik
	3978.0	7.6 Ik	4013.1	8.1 Ks
	3979.0	7.7 Ik	4014.0	8.1 Ik
	3980.0	7.7 Ik	4016.2	8.1 Ks
	3981.0	7.7 Ik	4020.0	8.2 Kk
	3984.0	7.8 Ik	4023.9	8.4 Kk
	3986.0	7.8 Ik	4024.0	8.6 Ik
	3987.0	7.8 Ik	4025.9	8.4 Kk
	3988.0	7.8 Ik	4030.9	8.7 Kk
	3990.0	7.8 Ik	4046.1	9.1 Ch
	3991.0	7.8 Ik	4047.5	9.7 Ya
	3995.0	7.8 Ik	4051.6	9.4 Pt
	3997.0	7.9 Ik	4051.6	9.3 Ks
	3999.0	7.9 Ik	4052.5	9.7 Ly
	4000.0	7.9 Ks	4053.5	9.8 Ie
	4000.1	8.0 Ik	4053.5	9.4 Ie
	4001.0	8.0 Ik	4060.5	10.0 Ly
	4001.1	7.9 Ks	4075.5	10.6 B
	4002.0	8.0 Ik	4081.5	11.0 Ie
	4002.1	7.9 Ks	4081.5	10.8 Pt
170627 RT HERCULIS—				
	4055.7	14.0 Wf	4077.6	14.3 Wf
	4064.7	14.3 Wf		
170833 RW SCORPII—				
	3972.2	11.3 Bl	4003.0	11.8 Bl
	3981.9	11.0 Bl	4016.0	12.6 Bl
	3993.9	11.8 Bl	4057.9	[13.0 Bl
171401 Z OPHIUCHI—				
	4051.6	11.7 Pt	4079.5	10.2 Pt
	4053.5	12.7 Ca	4090.5	9.6 Mz
	4059.5	11.6 Mz	4093.5	9.3 Mz
	4075.5	10.3 B	4100.5	8.8 B
171723 RS HERCULIS—				
	4000.0	10.3 Nk	4055.7	7.7 Wf
	4005.0	10.0 Nk	4064.6	7.7 Ks
	4006.0	9.7 Nk	4064.7	7.6 Wf
	4007.2	9.5 Nk	4075.6	7.8 Wf
	4015.0	9.5 Nk	4079.5	7.8 Pt
	4051.6	7.8 Pt		
172486 S OCTANTIS—				
	3972.2	11.7 Bl	4016.9	[13.0 Bl
	3993.9	12.8 Bl	4057.9	[13.5 Bl
172809 RU OPHIUCHI—				
	4051.6	9.5 Pt	4079.5	11.0 Pt
173411 RT SERPENTIS—				
	4071.3	9.5 L		

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
173543 RU SCORPII—				
	3972.2	10.8 Bl	4003.0	10.4 Bl
	3981.9	10.3 Bl	4017.0	10.0 Bl
	3993.9	10.4 Bl	4053.0	8.7 Bl
174135 SV SCORPII—				
	3972.2	10.1 Bl	4003.4	9.8 Bl
	3981.9	9.7 Bl	4017.0	9.9 Bl
	3993.9	9.4 Bl	4053.0	12.0 Bl
174163 W PAVONIS—				
	3972.2	9.0 Bl	4003.0	10.0 Bl
	3981.9	9.2 Bl	4016.9	10.5 Bl
	3993.9	9.6 Bl	4053.0	12.5 Bl
174406 RS OPHIUCHI—				
	4079.5	11.0 Pt		
175111 RT OPHIUCHI—				
	4073.6	[12.7 B		
175458a T DRACONIS—				
	4073.5	11.2 B	4089.6	10.8 Y
175458b UY DRACONIS—				
	4089.6	11.4 Y		
175519 RY HERCULIS—				
	4014.7	11.2 Lv	4075.5	13.7 Lv
	4034.6	12.6 Bi	4078.5	13.7 Ie
	4048.6	13.1 Ie	4079.5	13.2 Pt
	4051.6	12.9 Pt	4091.5	13.1 B
	4053.6	13.1 Bi	4091.6	13.5 Lv
	4053.6	13.2 Lv	4093.5	13.6 Bi
	4074.6	13.5 Lv	4104.5	13.3 Bi
175654 V DRACONIS—				
	4056.5	13.6 Ie	4084.5	11.5 Ie
	4062.6	12.9 W1		
180531 T HERCULIS—				
	3986.7	9.5 Cu	4055.6	9.7 Ca
	4001.1	8.1 Kk	4056.1	8.9 Nk
	4004.9	8.0 Kk	4056.2	9.6 Ch
	4005.1	7.9 Nk	4056.5	9.8 Ms
	4006.9	7.9 Kk	4056.6	9.7 Mx
	4007.1	8.0 Nk	4056.6	10.0 Hu
	4008.9	7.9 Kk	4056.6	9.6 Cu
	4010.9	7.9 Kk	4058.5	10.0 Ms
	4012.0	7.8 Kk	4058.6	10.0 Mx
	4013.9	7.7 Kk	4060.6	10.1 Ly
	4016.0	7.8 Kk	4061.6	10.0 Mx
	4016.9	7.7 Kk	4062.5	10.0 Ms
	4017.9	7.5 Kk	4062.6	10.8 Mz
	4019.9	7.5 Kk	4062.6	9.7 Cu
	4021.9	8.0 Kk	4064.6	10.8 Ks
	4025.9	8.4 Kk	4068.6	11.0 Ly
	4028.1	8.3 Kk	4069.5	11.1 Ie
	4030.9	8.5 Kk	4070.3	11.7 L
	4034.9	8.6 Kk	4075.6	12.0 Wf
	4038.1	9.1 Nk	4077.5	11.0 Ms
	4038.9	8.7 Kk	4078.5	11.0 Ms
	4045.9	9.0 Kk	4079.6	11.6 Pt
	4047.5	8.9 Ie	4080.7	11.3 Sg
	4048.4	8.9 L	4081.5	11.0 Ms
	4048.6	9.2 Jo	4084.5	11.0 Ms
	4050.6	9.1 Ca	4086.6	11.8 B
	4051.6	9.2 Pt	4091.5	11.0 Ms
	4051.7	9.4 Mz	4093.5	12.8 Ie

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
180531 T HERCULIS—Continued						
	4052.6	9.6	Ly	4095.7	13.0	Sg
	4053.7	9.6	Mx	4103.5	11.0	Ms
	4054.5	9.8	Ms	4104.5	11.0	Ms
	4054.6	9.6	Mx			
180565 W DRACONIS—						
	4017.7	9.9	Lv	4071.6	11.0	Lv
	4020.7	9.6	Lv	4071.6	11.5	Bi
	4034.6	9.8	Bi	4079.6	11.6	Lv
	4051.6	10.2	Pt	4079.6	11.5	Pt
	4053.6	10.1	Bi	4084.5	12.0	Ie
	4053.6	10.0	Lv	4091.5	11.7	B
	4056.5	10.6	Ie	4091.5	11.6	Lv
	4061.7	11.0	Bi	4103.5	12.3	B
	4065.7	11.1	Lv	4104.5	12.3	Bi
180666 X DRACONIS—						
	4020.7	[13.6	Lv	4079.5	11.7	Bi
	4053.6	13.5	Lv	4079.6	11.7	Pt
	4056.6	13.0	Ie	4084.5	11.5	Ie
	4065.7	13.5	Lv	4091.6	11.4	Lv
	4071.6	12.3	Lv	4103.5	11.5	B
	4071.6	12.5	Bi	4104.5	11.7	Bi
180911 NOVA OPHIUCHI—						
	4051.6	13.5	Pt	4079.5	13.5	Pt
181103 RY OPHIUCHI—						
	4014.7	9.2	Lv	4075.6	13.6	Wf
	4034.7	10.7	Bi	4069.6	13.5	Lv
	4051.6	12.6	Pt	4079.6	13.4	Pt
	4053.6	13.0	Bi	4084.6	13.3	Lv
	4053.6	12.7	Ca	4093.6	12.9	Bi
	4053.6	12.6	Lv	4104.5	10.7	Bi
	4074.5	13.0	Lv			
181136 W LYRAE—						
	4036.1	8.0	Mj	4057.9	8.3	Kk
	4036.1	7.7	Kk	4061.6	8.6	Ca
	4041.9	7.7	Kk	4061.7	8.5	Mz
	4045.9	7.6	Kk	4064.6	8.8	Ks
	4047.9	7.7	Kk	4068.6	9.0	Mz
	4048.1	8.0	Mj	4069.7	8.5	Sg
	4048.4	8.2	L	4070.4	8.9	L
	4048.6	9.6	Jo	4072.6	9.2	Cu
	4050.9	7.8	Kk	4072.6	9.1	B
	4051.1	8.2	Mj	4073.5	9.1	Mz
	4051.6	7.6	Pt	4075.6	9.2	Wf
	4051.6	8.2	Ks	4079.6	9.2	Pt
	4051.7	8.5	Mz	4082.6	9.3	Hu
	4052.6	8.3	Mz	4082.6	9.5	Cu
	4053.7	8.3	Ca	4087.6	9.7	Mz
	4054.0	7.9	Kk	4091.5	9.6	Mz
	4055.6	9.9	Jo	4093.6	9.7	Mz
	4056.1	8.7	Mj	4094.5	9.8	B
	4056.6	8.3	Hu	4109.6	10.8	Ks
182133 RV SAGITTARII—						
	3972.2	11.2	Bl	4017.0	13.5	Bl
	3981.9	11.3	Bl	4058.0	13.3	Bl
	3993.9	12.4	Bl			
182224 SV HERCULIS—						
	4050.4	14.3	L	4091.6	12.6	B
182306 T SERPENTIS—						
	4052.7	[12.8	Mz	4064.6	[12.2	Ks
	4062.6	[12.1	Mz	4090.5	[11.5	Mz
183149 SV DRACONIS—						
	4061.6	12.0	Wl	4089.5	12.7	Y
183308 X OPHIUCHI—						
	4005.1	8.3	Nk	4072.6	7.7	Cu
	4021.4	8.6	Sh	4073.6	8.0	B
	4047.6	8.0	Ya	4076.6	8.1	Lv
	4048.4	8.2	L	4079.6	7.6	Pt
	4051.7	8.2	Pt	4081.6	7.9	Ly
	4062.5	8.0	Ca	4096.5	8.0	Ly
	4052.6	8.2	Ly	4087.5	7.7	Cu
	4056.1	8.9	Nk	4091.5	7.7	Ly
	4060.6	8.2	Ly	4098.5	7.5	B
	4062.6	8.1	Cy	4104.5	7.8	Ly
	4068.6	8.0	Ly	4108.5	7.4	Ly
	4070.3	7.9	L			
184134 RY LYRAE—						
	4061.5	[13.3	Ie	4088.5	13.3	Ie
184205 R SCUTI—						
	4000.0	6.0	Kk	4064.6	5.7	Ks
	4001.1	6.0	Kk	4065.5	5.9	Pt
	4002.1	6.0	Kk	4067.3	5.9	An
	4003.0	6.1	Kk	4068.5	5.7	Ly
	4004.0	6.1	Kk	4068.5	5.4	Pt
	4004.9	6.1	Kk	4068.6	5.7	Mz
	4005.9	6.1	Kk	4069.5	5.4	Pt
	4006.9	6.0	Kd	4069.6	5.5	Cy
	4009.1	6.1	Kk	4069.6	5.9	Ks
	4010.1	6.2	Kk	4069.7	5.5	Sg
	4010.9	6.3	Kk	4070.5	5.5	Ie
	4012.0	6.6	Kk	4071.0	5.8	Kd
	4012.9	6.7	Kk	4071.5	5.1	Cu
	4013.9	6.8	Kk	4071.5	5.4	Pt
	4016.7	6.1	Al	4072.5	5.5	Cy
	4019.3	6.7	Sk	4072.5	5.6	Ca
	4019.9	7.0	Kk	4072.5	5.6	Cu
	4020.9	7.0	Kk	4072.5	5.3	Pt
	4021.4	6.7	Sh	4072.6	5.5	Kr
	4023.9	7.0	Kk	4072.9	5.7	Kd
	4025.9	7.0	Kk	4073.5	5.3	Cu
	4026.9	6.9	Kk	4073.5	5.8	Ms
	4027.0	6.8	Kd	4073.5	5.3	Pt
	4027.9	6.6	Kd	4074.3	5.6	An
	4028.0	7.1	Kk	4074.6	5.6	Ly
	4028.0	7.1	Kk	4074.9	5.7	Kd
	4028.9	7.2	H	4075.5	5.5	Ie
	4029.9	6.7	Kd	4075.5	5.6	Ks
	4030.9	7.0	Kk	4075.5	5.3	Pt
	4032.7	6.8	Sg	4075.6	5.9	Gb
	4034.4	7.0	An	4075.9	5.4	Kd
	4034.9	7.1	Kk	4076.2	5.6	An
	4035.9	6.7	Kd	4076.5	5.5	Ly
	4035.9	7.1	Kk	4076.5	5.3	Pt
	4038.9	6.9	Kk	4076.6	5.5	Hy
	4041.9	7.0	Kk	4076.6	5.5	Cy
	4042.9	6.6	Kd	4077.3	5.6	Ro
	4043.3	7.0	Sh	4077.5	5.6	Ms
	4044.6	6.5	Gb	4077.6	5.5	Mx

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
184205 R SCUTI—Continued.						
	4045.9	6.7	Kk	4078.5	5.5	Ms
	4045.9	6.5	Kd	4078.5	5.3	Pt
	4047.3	7.0	An	4078.5	5.4	Mx
	4047.5	6.5	Ie	4078.5	5.5	Ly
	4047.5	6.7	Ms	4078.6	5.9	Al
	4047.6	6.6	Jo	4078.6	4.9	Cu
	4047.6	6.9	Ya	4075.5	5.5	Ms
	4047.9	6.4	Kk	4079.5	5.3	Pt
	4048.4	6.9	An	4080.3	5.6	An
	4048.4	6.5	L	4080.5	5.5	Ms
	4048.6	6.5	Cy	4081.5	5.4	Ms
	4048.6	6.5	Hy	4081.5	5.4	Ly
	4050.3	6.6	An	4081.5	5.3	Pt
	4050.6	6.3	Ca	4081.6	5.8	Al
	4050.9	6.4	Kk	4082.5	5.3	Pt
	4051.6	6.5	Ks	4082.5	5.4	Ms
	4051.6	6.5	Gb	4082.5	5.3	Cy
	4051.7	6.2	Pt	4082.5	5.6	Cu
	4052.3	6.5	An	4082.5	5.3	Ie
	4052.5	6.3	Ly	4083.4	5.7	Cu
	4052.6	6.3	Gb	4083.5	5.3	Ms
	4052.6	6.2	Pt	4083.5	5.3	Pt
	4052.7	6.3	Mz	4083.5	5.4	Ks
	4053.5	6.4	Ca	4083.6	5.2	Mh
	4053.5	6.4	Ie	4084.5	5.3	Ms
	4053.5	6.5	Ms	4084.5	5.9	Kr
	4053.5	6.5	Mx	4084.5	5.5	Mz
	4053.6	6.3	Jo	4084.5	5.3	Mx
	4053.6	6.2	Ks	4084.9	5.3	Kd
	4053.6	6.3	Pt	4085.5	5.3	Ms
	4053.9	6.2	Kd	4085.3	5.3	Pt
	4054.0	6.4	Kk	4085.5	5.9	Kr
	4054.5	6.3	Ca	4086.5	5.4	Ly
	4054.5	6.3	Ly	4086.5	5.4	Ms
	4054.6	6.2	Cy	4087.5	5.6	Cu
	4054.6	6.2	Hy	4087.5	5.3	Ms
	4054.6	6.0	Ks	4087.5	5.3	Pt
	4054.6	6.2	Pt	4088.3	5.2	An
	4054.7	6.2	Kk	4088.4	5.7	Cu
	4055.5	6.3	Ca	4088.5	5.5	Ly
	4055.5	6.4	Ms	4088.5	5.3	Pt
	4055.5	6.4	Mx	4088.5	5.2	Ie
	4055.6	6.2	Pt	4089.5	5.4	Ms
	4056.5	6.3	Ca	4089.5	5.4	Pt
	4056.5	6.3	Mx	4089.5	5.4	Mx
	4057.1	6.0	Ch	4089.6	5.5	Mz
	4057.5	6.3	Ms	4090.5	5.4	Ks
	4057.9	6.5	Kk	4091.5	5.1	Ly
	4058.3	6.0	An	4091.5	5.5	Mz
	4058.5	6.3	Ms	4091.5	5.3	Pt
	4058.5	6.3	Mx	4091.5	5.3	Ms
	4058.9	6.3	Kk	4091.5	5.3	Mx
	4059.3	6.3	An	4091.5	5.1	Cy
	4059.6	6.2	Mx	4091.5	5.2	Hy
	4059.7	6.1	Pt	4091.5	5.2	Pt
	4060.5	6.3	Ie	4093.5	5.7	Mz
	4060.5	6.0	Ly	4093.5	5.2	Pt
	4060.5	6.2	Ms	4093.5	5.2	Ms
	4060.6	6.1	Pt	4094.5	5.3	Pt
184205 R SCUTI—Continued.						
	4060.9	5.6	Kd	4095.5	5.4	Pt
	4061.5	6.0	Ca	4096.5	5.2	Pt
	4061.5	6.1	Ms	4099.5	5.2	Pt
	4061.5	6.0	Mx	4100.5	5.3	Pt
	4061.5	6.0	Kr	4100.5	5.4	Ie
	4061.5	5.9	Pt	4102.5	5.2	Pt
	4061.6	5.9	Ks	4103.5	5.4	Ms
	4061.6	5.9	Ly	4103.5	5.4	Mx
	4062.5	6.0	Ca	4104.5	5.8	Gb
	4062.5	5.8	Ly	4104.5	5.6	Ms
	4062.5	6.0	Ms	4104.5	5.4	Ly
	4062.5	6.0	Pt	4105.5	5.2	Pt
	4062.6	5.8	Cm	4105.6	5.6	Mh
	4062.6	5.5	Cy	4106.5	5.2	Pt
	4062.7	5.8	Mz	4107.5	5.5	Ie
	4063.6	5.7	Mz	4108.5	5.3	Ly
	4064.4	5.9	An	4108.5	5.7	Mh
	4064.5	5.8	Ie	4108.5	5.3	Pt
	4064.5	5.8	Sh	4109.6	5.4	Ks
184243 RW LYRAE—						
	4075.6	[13.2	B			
184300 NOVA AQUILAE. #3—						
	4000.0	10.4	Nk	4062.5	10.4	Ca
	4005.0	10.4	Nk	4062.6	10.3	Mz
	4006.0	10.4	Nk	4068.5	10.5	Pt
	4047.5	10.3	Ie	4071.7	10.3	Sg
	4051.7	10.4	Pt	4077.3	10.7	Ro
	4052.6	10.3	Mz	4078.5	10.4	Ie
	4055.6	10.5	Pt	4078.5	10.2	Pt
	4056.0	10.4	Nk	4083.5	10.5	Pt
	4057.2	10.3	Ch	4084.6	10.3	Mz
	4060.5	10.4	Gd	4100.5	10.3	Ie
	4061.5	10.2	Pt	4106.5	10.3	Pt
185032 RX LYRAE—						
	4051.7	[12.5	Mz	4084.6	[12.5	Mz
	4063.2	[11.5	Ch			
185437a S CORONAE AUSTRALIS—						
	3972.2	12.5	Bl	4017.0	11.6	Bl
	3993.9	11.6	Bl	4053.0	12.0	Bl
	4003.0	12.8	Bl			
185537a R CORONAE AUSTRALIS—						
	3972.2	13.0	Bl	4017.0	11.3	Bl
	3993.9	12.9	Bl	4058.0	13.2	Bl
	4003.0	12.2	Bl			
185537b T CORONAE AUSTRALIS—						
	3972.2	13.5	Bl	4017.0	[13.0	Bl
	3993.9	13.5	Bl	4058.0	[13.2	Bl
185634 Z LYRAE—						
	4075.6	13.4	B	4096.6	[13.3	B
	4091.6	13.7	B			
185737 RT LYRAE—						
	4063.2	[11.1	Ch			
185905 V AQUILAE—						
	4019.3	7.7	Sh	4060.3	7.9	Sh
	4021.4	7.8	Sh			

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
190108 R AQUILAE—						
	4052.6	11.4	Pt	4079.6	10.7	Pt
	4052.7	11.6	Mz	4084.6	11.1	Mz
	4054.6	11.8	Ca	4086.6	10.3	B
	4072.6	9.7	B	4089.6	9.6	B
	4078.5	11.3	Cu	4089.6	10.7	Mz
190529a V LYRAE—						
	4052.6	13.0	Pt	4079.6	13.5	Pt
190818 RX SAGITTARII—						
	4064.1	[11.1	Ch			
190819a RW SAGITTARII—						
	4003.6	9.0	B	4052.6	10.3	Pt
	4046.1	9.8	Ch	4079.6	8.2	Pt
190907 TY AQUILAE—						
	4052.6	9.7	Pt	4079.6	11.7	Pt
	4055.6	10.4	Ca			
190925 S LYRAE—						
	4020.7	13.7	Lv	4081.6	11.6	Bi
	4052.6	12.6	Pt	4081.6	12.1	Lv
	4053.6	12.9	Bi	4089.5	11.9	B
	4053.6	13.0	Lv	4089.6	11.6	Mz
	4061.6	12.5	Bi	4091.6	12.2	Lv
	4061.6	12.4	Lv	4103.6	12.3	B
	4079.6	11.7	Pt	4104.6	12.5	Bi
190926 X LYRAE—						
	4052.6	9.0	Pt	4079.6	9.0	Pt
190933a RS LYRAE—						
	4020.7	12.7	Lv	4053.7	13.9	Lv
	4030.7	13.0	Bi	4059.6	13.9	Lv
	4053.7	13.9	Bi	4063.2	10.6	Ch
190941 RU LYRAE—						
	4048.6	13.2	Ie	4079.6	11.4	Pt
	4061.6	13.0	Wl	4100.5	11.1	Ie
	4076.6	12.0	Ie			
190967a U DRACONIS—						
	4032.1	10.3	Ch	4057.2	10.5	Ch
	4052.6	10.0	Hu	4079.6	11.0	Pt
	4053.6	10.2	Pt	4082.6	11.0	Hu
	4055.6	10.1	Ie	4083.5	11.9	Ie
	4061.6	10.8	Wl			
191007 W AQUILAE—						
	4052.6	10.9	Pt	4079.6	10.0	Pt
	4055.6	11.2	Ca			
191017 T SAGITTARII—						
	4046.1	10.4	Ch	4079.6	10.9	Pt
	4053.6	9.8	Pt			
191019 R SAGITTARII—						
	4053.5	7.4	Ca	4068.6	8.4	Mz
	4053.6	7.0	Pt	4072.5	8.0	Ca
	4059.6	8.1	Mz	4074.6	8.8	Mz
	4061.5	7.9	Ca	4079.6	8.3	Pt
	4063.5	8.1	Mz	4084.5	9.6	Mz
	4064.1	7.2	Ch			
191033 RY SAGITTARII—						
	3972.0	9.0	Bl	4068.5	7.9	Pt
	3976.0	9.0	Bl	4069.5	7.8	Pt
	3981.9	8.8	Bl	4071.5	7.8	Pt
	3985.0	8.9	Bl	4072.5	7.9	Pt
	3993.9	9.0	Bl	4073.5	7.8	Pt
	4003.0	9.0	Bl	4075.5	7.7	Pt
191033 RY SAGITTARII—Continued.						
	4017.0	8.6	Bl	4076.5	7.7	Pt
	4030.3	8.6	L	4078.5	7.7	Pt
	4046.1	10.4	Ch	4079.5	7.7	Pt
	4048.3	7.9	L	4081.5	7.7	Pt
	4051.7	7.7	Pt	4082.5	7.8	Pt
	4052.6	7.8	Pt	4083.5	7.8	Pt
	4053.0	8.0	Bl	4085.5	7.8	Pt
	4053.6	7.8	Pt	4087.5	7.8	Pt
	4054.6	7.8	Pt	4092.5	7.8	Pt
	4055.6	7.8	Pt	4093.5	7.7	Pt
	4060.6	7.8	Pt	4094.5	7.7	Pt
	4061.5	7.9	Pt	4099.5	7.7	Pt
	4062.5	7.8	Pt	4102.5	7.7	Pt
	4065.5	7.8	Pt	4106.5	7.7	Pt
	4067.5	7.8	Pt	4108.5	7.6	Pt
191124 TY SAGITTARII—						
	3993.9	[13.5	Bl	4058.0	13.2	Bl
	4017.0	[13.0	Bl			
191319 S SAGITTARII—						
	4017.0	13.5	Bl	4061.5	10.0	Ca
	4053.5	10 5	Ca	4072.5	9.9	Ca
	4053.0	10.8	Bl	4079.6	9.8	Pt
	4053.6	10.3	Pt	4079.6	12.1	Pt
191331 SW SAGITTARII—						
	3994.0	[12.9	Bl	4058.0	[13.4	Bl
	4017.0	[13.0	Bl			
191350 TZ CYGNI—						
	4053.6	10.5	Pt	4089.6	11.5	Mz
	4061.6	10.9	Wl	4089.6	11.4	Pt
	4079.6	11.8	Pt			
191637 U LYRAE—						
	4053.6	10.8	Pt	4079.6	11.0	Pt
191717 T SAGITTARII—						
	4019.3	9.4	Sh	4021.4	9.6	Sh
192745 AF CYGNI—						
	4002.1	7.2	Ks	4009.6	7.1	Ks
	4004.9	7.2	Ks	4013.1	7.1	Ks
192928 TY CYGNI—						
	4053.6	9.2	Pt	4079.6	9.7	Pt
	4057.2	9.7	Ch			
193311 RT AQUILAE—						
	4005.1	10.4	Nk	4079.6	13.0	Pt
	4054.6	12.6	Ie	4081.6	13.0	Ie
	4072.6	12.8	B	4089.6	13.0	B
193449 R CYGNI—						
	3991.9	8.4	Ks	4073.6	8.9	Mz
	3992.7	9.3	Al	4074.6	8.5	Ly
	3996.9	9.2	Ks	4075.6	8.8	Wf
	4001.9	7.8	Ks	4076.6	8.3	Lv
	4007.1	7.4	Ks	4076.6	9.4	Jo
	4009.1	7.1	Ks	4077.6	9.1	Ms
	4011.5	6.8	Ks	4078.5	9 1	Mx
	4012.1	6.7	Ks	4078.5	9.1	Ms
	4013.5	6.7	Ks	4078.6	8.4	Al
	4016.0	6.6	Ks	4078.7	7.5	Gb
	4017.9	6.5	Kk	4081.5	8.0	Pt
	4021.0	6.5	Kk	4081.5	9.0	Ms
	4022.0	6.5	Kk	4081.6	8.5	Al
	4022.8	7.8	Bi	4081.6	8.5	Ly

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
193449 R CYGNI—Continued.						
	4026.6	7.0	Kr	4082.5	9.0	Ms
	4047.6	7.7	Jo	4082.6	9.2	Cu
	4048.6	8.2	Hy	4082.6	8.9	Hu
	4048.7	8.2	Cy	4082.6	8.2	Bi
	4051.6	8.0	Hu	4082.6	9.6	Jo
	4051.7	8.8	Lv	4082.7	9.2	Cy
	4051.7	8.2	Bi	4083.6	9.0	Ms
	4051.8	9.0	Mz	4083.8	8.5	Sσ
	4052.6	8.5	Ly	4084.6	9.5	Mz
	4053.6	7.8	Pt	4084.7	8.9	Ms
	4053.7	8.0	Lv	4085.6	8.9	Ms
	4053.7	8.0	Gb	4086.5	8.5	Ly
	4053.7	8.0	Ca	4086.6	8.9	Ms
	4053.7	8.5	Bi	4087.6	9.1	Ms
	4054.6	7.4	Ks	4088.6	8.7	Lv
	4055.6	7.6	Jo	4088.7	9.0	Ms
	4058.5	8.5	Ms	4089.5	9.8	Mx
	4058.6	8.6	Mx	4089.5	8.8	Ie
	4058.7	8.3	Lv	4089.7	9.7	Kr
	4059.2	8.4	Ch	4090.6	9.3	I
	4060.5	8.4	Ly	4090.6	9.0	Ks
	4060.5	8.4	Ms	4091.5	9.6	Mz
	4061.5	8.4	Bi	4091.5	9.7	Mx
	4061.6	8.3	Mx	4091.6	8.6	Ly
	4061.6	8.5	Bi	4091.7	9.3	Ms
	4061.6	8.4	Lv	4091.7	9.5	Hy
	4061.7	8.0	Ca	4093.6	8.6	Bi
	4062.5	8.3	Ms	4093.6	8.9	B
	4062.6	8.3	Ie	4093.6	9.2	Ms
	4064.6	8.4	Jo	4094.6	8.8	B
	4065.7	9.0	Mz	4094.6	9.3	I
	4066.6	8.1	Lv	4098.5	9.7	Mz
	4067.7	8.8	Cy	4099.5	8.6	Bi
	4067.8	8.5	Sg	4103.5	9.5	Ms
	4068.6	8.1	Ly	4104.5	9.5	Ms
	4071.6	9.1	Jo	4104.5	9.5	Ly
	4071.6	8.3	Cu	4104.6	9.7	Jo
	4071.7	8.2	Bi	4104.6	8.9	Bi
	4071.7	8.4	Lv	4107.5	9.6	Ly
193509 RV AQUILAE—						
	4053.6	9.8	Pt	4081.5	10.6	Pt
	4054.6	10.2	Ie			
193732 TT CYGNI—						
	4051.6	7.0	Hu	4097.6	7.7	B
	4082.6	7.0	Hu			
193973 T PAVONIS—						
	3972.2	11.5	Bl	4003.1	8.8	Bl
	3983.9	10.8	Bl	4017.1	8.5	Bl
	3994.0	9.9	Bl	4053.1	8.7	Bl
194048 RT CYGNI—						
	4036.1	7.7	Mj	4077.6	8.2	Ms
	4047.6	7.3	Jo	4078.5	8.1	Ms
	4048.1	7.5	Mj	4078.7	8.0	Gb
	4048.5	8.2	Mx	4080.5	8.4	Ms
	4048.6	7.3	Cy	4080.5	8.5	Lv
	4048.6	7.3	Hy	4081.5	8.3	Ms
	4051.1	7.5	Mj	4081.5	8.3	Pt
	4051.6	7.0	Hu	4081.6	8.8	Al
	4051.8	7.9	Mz	4082.5	8.6	Cu
	4053.7	7.5	Gb	4082.6	9.0	Jo
	4053.7	7.5	Pt	4082.7	9.3	Hu
	4053.7	7.4	Ca	4082.7	8.7	Cy
	4054.6	7.8	Ks	4083.6	8.6	Ms
	4055.6	7.5	Jo	4083.8	8.7	Sg
	4056.1	7.7	Mj	4084.6	8.7	Mz
	4058.5	7.7	Ms	4087.6	9.0	Ms
	4058.6	7.7	Mx	4088.7	9.0	Ms
	4059.2	7.2	Ch	4089.5	9.2	Mx
	4059.6	7.8	Mx	4090.6	8.7	Ks
	4060.6	7.5	Ms	4091.5	9.2	Mx
	4061.6	7.7	Mx	4091.5	9.1	Mz
	4061.7	7.3	Ca	4091.5	9.2	Ms
	4062.5	7.6	Ms	4093.5	9.1	Mz
	4062.7	7.6	Cy	4093.6	9.2	Ms
	4064.6	7.8	Jo	4094.6	9.0	B
	4065.7	8.0	Mz	4103.5	9.4	Ms
	4067.8	7.8	Sg	4104.5	9.7	Ms
	4071.6	8.1	Cu	4104.5	9.7	Mx
	4073.6	8.0	Mz	4104.6	9.4	Bi
	4076.6	8.4	Jo			
194348 TU CYGNI—						
	4054.6	13.3	Bi	4071.6	12.8	Lv
	4054.6	13.2	Lv	4081.5	12.2	Pt
	4061.6	12.9	Bi	4081.6	12.0	Lv
	4061.6	12.9	Lv	4082.6	12.0	Hu
	4061.6	12.6	Wl	4091.6	11.9	Lv
	4071.6	12.8	Bi	4104.6	10.9	Bi
194604 X AQUILAE—						
	4055.7	14.0	Wf	4090.6	13.5	Lv
	4064.7	13.8	Wf	4093.6	13.3	Bi
	4075.5	13.3	Lv	4104.5	13.3	Bi
	4085.6	13.2	Lv			
194632 χ CYGNI—						
	4000.0	13.3	Nk	4077.6	9.6	Ch
	4015.0	12.2	Nk	4081.5	9.0	Pt
	4021.0	11.8	Nk	4082.6	9.4	Cu
	4036.1	11.4	Nk	4082.6	8.7	Hu
	4048.1	10.8	Nk	4084.6	8.8	Ms
	4051.8	10.5	Mz	4084.6	9.3	I
	4053.7	10.2	Pt	4084.7	9.5	Mz
	4056.0	10.3	Nk	4090.6	9.1	I
	4059.0	10.3	Nk	4091.6	8.6	B
	4059.2	10.5	Ch	4091.6	9.3	Mz
	4065.8	9.9	Mz	4093.5	9.0	Mz
	4073.6	9.7	Cu	4094.6	9.0	I
	4075.6	9.6	Wf	4096.6	7.9	B
	4076.6	9.5	I			
194930 RR SAGITTARII—						
	3972.9	12.1	Bl	4017.1	9.6	Bl
	3994.0	11.2	Bl	4053.1	6.9	Bl
	4003.0	10.7	Bl			
195142 RU SAGITTARII—						
	3972.9	9.9	Bl	4003.0	11.4	Bl
	3981.9	10.3	Bl	4017.1	12.2	Bl
	3994.0	11.4	Bl	4058.0	12.9	Bl
195202 RR AQUILAE—						
	4053.7	11.0	Pt	4086.6	12.3	B
	4071.6	11.7	B	4098.6	12.5	B
	4081.5	11.9	Pt			

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
195308 RS AQUILAE—						
	4054.6	[12.3	Ca	4086.6	11.8	B
	4081.5	11.9	Pt			
195553 NOVA CYGNI #3—						
	4030.0	11.9	Nk	4075.7	11.8	Pt
	4051.7	11.9	Pt	4075.6	12.2	B
	4053.7	11.9	Bi	4078.5	12.0	Pt
	4053.7	12.1	Lv	4079.6	12.1	Lv
	4055.5	11.9	Ie	4082.5	12.0	Pt
	4059.5	12 3	Bi	4083.6	12.0	Ie
	4059.6	12.1	Lv	4089.5	12.1	Pt
	4059.7	11.8	Pt	4091.7	12.2	Pt
	4061.6	12 0	Wl	4102.5	12.2	Pt
	4071.7	11.8	Pt	4106.5	12.2	Pt
	4072.6	12.3	Bi			
195849 Z CYGNI—						
	4053 7	11.3	Pt	4075.6	12.5	Wf
	4055.7	11.6	Wf	4081.5	12.6	Pt
	4059.6	11.8	Mz	4084.7	11.9	Mz
	4061.6	11.7	Wl	4089.6	12.5	Ie
	4064.6	12.3	Ie	4089.6	12.6	B
	4064.6	12.3	Wf			
195855 S TELESCOPII—						
	3994.1	12 3	Bl	4058.0	13.1	Bl
	4017.1	12.9	Bl			
200212 SY AQUILAE—						
	4050.4	14.0	L	4089.6	[13.5	B
200357 S CYGNI—						
	4051.7	12.6	Lv	4075.7	11.3	Wf
	4051.7	12.6	Bi	4075.8	11.8	Sg
	4053.7	12.8	Pt	4080.6	11.3	Lv
	4059 7	12.5	Bi	4081.5	11.5	Pt
	4059.7	12.6	Lv	4081.6	9.9	Ie
	4061 6	12.3	Wl	4089.8	10.6	Sg
	4064.6	11.9	Ie	4091.6	10.7	Lv
	4071.6	11.7	Bi	4104.6	10.6	Bi
	4071.6	12.0	Lv			
200514 R CAPRICORNI—						
	4053.7	12 4	Bi	4072.5	12.0	Lv
	4053.7	12.5	Lv	4081.5	12.0	Pt
	4059.7	12 4	Bi	4085.6	12.0	Lv
	4059.7	12 4	Lv	4098.5	11.1	B
	4070.6	11.6	B	4104.5	11.3	Bi
200647 SV CYGNI—						
	4076.6	8.8	Hu			
200715a S AQUILAE—						
	3991 6	10.0	Gd	4075.7	9.2	Wf
	4053.7	9.5	Pt	4081.6	9.3	Pt
	4060 5	9.4	Gd	4094.6	9.7	B
	4071.6	9.2	B			
200715b RW AQUILAE—						
	4053.7	9.1	Pt	4081.6	9.1	Pt
	4063.2	9.4	Ch	4094.6	9.3	B
	4071.6	9 2	B			
200747 R TELESCOPII—						
	3994.1	[13.5	Bl	4058.0	13.4	Bl
	4017.1	[13.5	Bl			
200812 RU AQUILAE—						
	4054.6	9.8	Bi	4084.7	11.2	Bi
	4054.6	9.4	Lv	4086.6	11.1	B
	4065.6	9.8	Bi	4088.6	11.4	B
	4065.7	9.9	Lv	4088.6	11.0	Lv
	4072.5	10.3	Lv	4099.5	11.7	Bi
	4072.6	10.2	B	4100.6	12.0	B
	4082.6	10.6	Bi			
200822 W CAPRICORNI—						
	3994.0	[13.0	Bl	4073.5	[10.3	Cu
	4017.1	[12.8	Bl	4081.6	11.5	Pt
	4058.0	13.4	Bl	4089.5	11.6	Y
200906 Z AQUILAE—						
	4053.7	10.1	Pt	4081.6	9.8	Pt
	4054.6	10.4	Ie	4094.6	9.0	B
	4081.6	9.9	Ie			
200916 R SAGITTAE—						
	4071.6	8.8	B			
200938 RS CYGNI—						
	3992.7	7.9	Al	4067.7	9.1	Cy
	4016.7	7.9	Al	4072 6	8.8	Cy
	4030.4	7.9	L	4076.6	9.5	Jo
	4045.1	8.9	Ch	4076.7	8.8	Cy
	4046.2	9.0	Ch	4076.7	8.4	Hy
	4048.4	8.3	L	4078.6	8.8	Al
	4048.6	9.0	Hy	4081.6	9.0	Ly
	4048.6	9.1	Cy	4081.6	8.3	Al
	4052.6	8.6	Ly	4081.6	8.0	Pt
	4052.6	8.5	Pt	4082.7	8.7	Cy
	4052.7	9.0	Cy	4084.6	8.3	Al
	4054.6	8.9	Al	4086.5	8.9	Ly
	4055.5	9.1	Ly	4089.7	9.0	Kr
	4055.6	9.2	Jo	4089.8	8.7	Sg
	4058 5	8.0	L	4091.6	8.9	Ly
	4059.2	9.1	Ch	4093.6	8.4	Cy
	4062.7	9.1	Cy	4104.5	8.4	Ly
	4065.7	9.5	Jo	4104.5	8.7	Ly
	4067.8	8.8	Sg			
201008 R DELPHINI—						
	4047.6	11.3	Ie	4081.6	8.6	Pt
	4052.6	11.0	Pt	4082.6	7.5	Jo
	4059.7	10.5	Mz	4089.6	9.0	Mz
	4061.5	10 3	Gd	4091.6	9 0	Mz
	4063.2	10.1	Ch	4093.6	8.9	Mx
	4069.5	9.5	Ie	4093.6	8.7	B
	4076.6	7.3	Jo	4094.5	8.7	Ie
201121 RT CAPRICORNI—						
	4029.9	7.4	Kd	4073.9	7.5	Kd
	4045.9	7.5	Kd	4081.6	6.4	Pt
	4053.6	6.6	Pt	4082.5	7.4	Cu
	4073.5	7.4	Cu	4084.9	7.6	Kd
201130 SX CYGNI—						
	4052.6	11.3	Pt	4076.6	12.7	Hy
	4055.7	11.6	Cy	4081.6	12 7	Pt
	4062.7	12 4	Cy	4088.6	12.7	Ie
	4064.6	11.7	Ie	4089.6	12.6	B
	4067.7	12.0	Cy	4089.6	12.7	Y
	4076.6	12.6	Cy			

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Star	J.D.	Est.Obs.	J.D.	Est.Obs.
201139 RT SAGITTARII—				
	3972.9	9.3 Bl	4017.2	7.4 Bl
	3981.9	9.0 Bl	4052.6	6.4 Bl
	3994.0	8.8 Bl	4053.1	6.3 Bl
	4003.0	8.3 Bl		
201437b WX CYGNI—				
	4048.6	10.7 Cy	4072.6	9.4 Bi
	4048.6	10.6 Hy	4072.6	9.3 Bi
	4051.7	10.2 Bi	4081.6	10.5 Ly
	4051.7	10.5 Lv	4081.6	9.6 Pt
	4052.6	9.3 Pt	4081.6	10.6 Al
	4052.7	10.8 Cy	4082.7	10.5 Cy
	4054.6	10.6 Ks	4082.7	9.7 Bi
	4055.6	10.8 Cy	4084.7	10.7 Mz
	4059.2	10.3 Ch	4084.7	9.9 Bi
	4059.6	10.7 Mz	4086.5	10.4 Ly
	4059.7	10.1 Bi	4087.8	10.5 Sg
	4059.7	10.3 Lv	4088.5	10.6 Ie
	4061.6	10.5 Ks	4088.6	9.2 B
	4062.5	10.5 Ie	4088.6	10.5 Lv
	4062.7	10.7 Cy	4090.6	9.6 Ks
	4065.7	10.0 Bi	4091.6	10.5 Ly
	4065.7	10.3 Lv	4093.6	10.5 Cy
	4067.7	10.6 Cy	4093.6	10.4 Ly
	4067.8	10.5 Sg	4099.5	9.6 Bi
	4068.7	10.3 Bi	4102.6	9.2 B
	4071.5	10.4 Cy	4104.5	10.0 Ly
	4071.5	10.8 Hy	4104.6	9.5 Bi
	4072.6	10.8 Cy		
201647 U CYGNI—				
	3986.6	9.0 Gd	4077.3	7.7 Ro
	4002.1	8.7 Kk	4078.6	7.7 Cu
	4006.9	8.7 Kk	4078.6	7.8 Al
	4008.9	8.6 Kk	4081.1	7.8 Mj
	4019.9	8.2 Kk	4081.6	7.3 Pt
	4023.9	8.1 Kk	4083.8	7.5 Sg
	4028.9	8.0 Kk	4084.7	7.8 Mz
	4035.0	8.2 Kk	4084.7	7.6 Ms
	4039.9	8.2 Kk	4085.6	7.8 Al
	4045.9	7.8 Kk	4086.6	7.6 Ms
	4049.7	7.6 Jo	4087.6	7.6 Ms
	4050.9	7.8 Kk	4088.6	7.6 Ms
	4051.1	7.8 Mj	4089.5	7.8 Mx
	4051.8	7.8 Mj	4089.6	7.6 Ms
	4052.6	7.6 Pt	4091.5	7.7 Mx
	4053.7	7.7 Ca	4091.5	7.6 Ms
	4054.0	7.7 Kk	4091.6	7.7 Lv
	4056.1	7.7 Mj	4091.6	7.8 Mz
	4058.9	7.7 Kk	4093.6	7.7 Ms
	4059.7	7.8 Mz	4093.6	7.5 B
	4061.7	7.5 Jo	4093.6	7.9 Mz
	4061.6	8.0 Wl	4103.5	7.6 Ms
	4061.7	8.0 Ca	4104.5	7.7 Mx
	4067.8	7.5 Sg	4104.5	7.6 Ms
	4068.6	7.7 Mz	4104.6	7.9 Bi
	4071.6	7.7 Cu	4105.6	8.0 Mh
	4071.7	7.3 Jo	4108.6	8.0 Mh
	4073.6	7.7 Mz	4109.6	7.6 Ks
202240 U MICROSCOPII—				
	3994.0	[13.6 Bl	4053.1	13.5 Bl
	4003.0	[13.6 Bl	4058.0	13.2 Bl
	4017.2	[12.1 Bl		
202817 Z DELPHINI—				
	4050.6	9.5 Ie	4072.6	9.0 Bi
	4052.6	9.5 Pt	4073.6	9.4 Mz
	4054.7	9.2 Bi	4081.6	9.4 Pt
	4054.7	9.3 Bi	4084.7	9.4 Bi
	4054.7	9.2 Lv	4088.6	9.7 Lv
	4059.7	9.2 Mz	4089.6	9.6 Ie
	4061.5	9.0 Gd	4089.6	9.6 Mz
	4063.6	9.4 Mz	4091.6	9.7 Mz
	4065.7	9.0 Bi	4093.6	9.7 B
	4065.7	9.2 Bi	4093.6	9.8 Mz
	4065.7	8.9 Lv	4099.6	10.0 Bi
	4070.5	9.0 Ie		
202946 SZ CYGNI—				
	4051.6	9.8 Pt	4082.6	9.8 Pt
	4052.6	9.6 Pt	4083.5	9.7 Pt
	4053.6	9.6 Pt	4084.8	9.2 Pt
	4055.6	9.0 Pt	4085.5	9.2 Pt
	4059.7	8.8 Pt	4087.5	8.9 Pt
	4060.6	8.9 Pt	4088.5	8.8 Pt
	4061.5	9.1 Pt	4089.5	8.9 Pt
	4062.5	9.2 Pt	4090.8	9.0 Pt
	4064.5	9.5 Pt	4091.7	9.0 Pt
	4067.6	9.6 Pt	4092.5	9.1 Pt
	4068.5	9.3 Pt	4093.5	9.7 Pt
	4069.5	9.0 Pt	4094.5	9.7 Pt
	4070.7	9.0 Pt	4095.5	9.9 Pt
	4071.5	8.8 Pt	4096.5	9.8 Pt
	4072.5	8.8 Pt	4099.5	9.8 Pt
	4073.5	8.8 Pt	4100.5	9.5 Pt
	4075.5	9.0 Pt	4101.6	8.7 Pt
	4076.5	9.0 Pt	4102.5	8.9 Pt
	4078.5	9.6 Pt	4106.5	9.5 Pt
	4079.6	9.6 Pt	4108.5	9.7 Pt
	4081.6	9.8 Pt		
202954 ST CYGNI—				
	4052.6	11.6 Pt	4082.6	10.9 Hu
	4061.6	11.3 Wl	4088.6	11.1 B
	4062.6	10.8 Ie	4089.6	11.0 Ie
	4076.6	11.7 Hu	4089.6	10.4 Y
	4080.6	10.3 Lv	4103.6	10.3 B
	4081.6	10.8 Pt	4104.6	10.4 Bi
203226 V VULPECULAE—				
	4052.6	9.4 Pt	4081.6	8.6 Pt
203429 R MICROSCOPII—				
	3994.0	13.5 Bl	4017.2	11.0 Bl
	4003.1	12.6 Bl	4053.1	9.6 Bl
203611 Y DELPHINI—				
	4089.7	13.2 B	4103.5	[13.0 B
	4090.6	[12.1 Ks		
203816 S DELPHINI—				
	4048.1	11.1 Nk	4081.6	11.9 Pt
	4052.6	11.8 Pt	4087.6	12.1 B
	4071.6	11.4 B		

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
203847 V CYGNI—						
	4045.1	11.0	Ch	4077.7	9.5	Bi
	4051.7	10.3	Bi	4079.6	10.3	Lv
	4051.7	10.8	Lv	4081.6	9.0	Pt
	4052.6	10.0	Pt	4084.7	9.6	Bi
	4059.7	9.8	Bi	4090.6	9.5	Bi
	4059.7	10.7	Lv	4090.6	10.0	Lv
	4059.2	11.0	Ch	4093.6	10.4	Lv
	4065.7	9.4	Bi	4093.6	9.4	Bi
	4065.7	9.8	Lv	4093.6	9.3	B
	4071.7	9.4	Bi	4099.6	9.3	Bi
	4071.7	9.8	Lv	4104.7	10.2	Wf
	4075.7	10.2	Wf			
203905 Y AQUARII—						
	4047.6	10.8	Ie	4081.6	12.0	Pt
	4052.6	11.7	Cg	4087.6	11.8	B
	4052.6	11.1	Pt	4098.6	12.1	B
	4070.6	11.3	Ie	4104.5	12.4	Ie
204016 T DELPHINI—						
	4024.7	9.8	Sg	4069.5	9.9	Ie
	4047.6	9.5	Ie	4071.6	9.8	B
	4048.5	9.4	Cy	4075.7	10.5	Wf
	4048.6	9.4	Hy	4076.6	10.3	Cy
	4052.6	9.4	Pt	4076.6	10.1	Hy
	4055.7	9.1	Wf	4081.6	10.3	Pt
	4059.7	9.7	Mz	4082.7	10.7	Cy
	4061.5	9.7	Gd	4083.8	11.0	Sg
	4062.6	9.7	Cy	4084.6	10.9	Mz
	4063.2	9.7	Ch	4087.6	10.5	B
	4059.7	9.7	Mz	4090.8	11.4	Pa
	4064.7	9.7	Wf	4093.6	11.2	Ie
	4068.7	9.8	Mz	4100.6	11.0	B
	4068.8	9.9	Sg			
204102 V AQUARII—						
	4019.3	8.5	Sh	4060.3	9.0	Sh
	4021.4	8.5	Sh	4075.6	8.8	B
	4022.4	8.6	Sh	4081.6	8.5	Pt
	4052.6	8.5	Pt	4101.6	8.8	B
204104 W AQUARII—						
	4048.4	13.0	L	4089.6	13.8	B
	4075.6	13.8	B	4105.6	13.7	B
204215 U CAPRICORNI—						
	3994.1	13.7	Bl	4105.	12.0	B
	4089.6	13.3	B			
204318 V DELPHINI—						
	4024.7	9.5	Sg	4083.8	11.4	Sg
	4068.8	10.5	Sg	4087.7	11.7	B
	4075.7	11.5	B	4101.6	12.2	B
	4082.6	11.2	Hu			
204405 T AQUARII—						
	4050.6	11.7	Ca	4077.7	8.3	Sg
	4052.6	11.8	Pt	4081.6	13.4	Pt
	4055.6	9.4	Jo	4089.5	13.6	B
	4075.6	12.6	B	4105.6	13.0	B
204846 RZ CYGNI—						
	4052.6	10.3	Pt	4077.7	10.0	Bi
	4053.8	10.5	Bi	4079.6	10.5	Lv
	4053.8	10.6	Lv	4081.6	10.6	Pt
	4055.7	10.5	Wf	4084.7	10.4	Bi
	4062.6	10.2	Ie	4087.8	10.8	Sg
204846 RZ CYGNI—Continued.						
	4064.7	10.5	Wf	4089.6	10.4	B
	4065.7	10.1	Bi	4089.6	11.0	Ie
	4065.7	10.1	Lv	4090.6	11.0	Lv
	4067.8	10.9	Sg	4093.6	10.5	Bi
	4071.7	10.2	Bi	4099.6	10.7	Bi
	4071.7	10.6	Lv	4104.6	10.9	Bi
	4075.7	10.9	Wf			
204954 S INDI—						
	3994.1	[13.8	Bl	4058.0	[13.5	Bl
	4017.1	[13.5	Bl			
205017 X DELPHINI—						
	4052.6	11.9	Pt	4088.6	8.9	Lv
	4058.7	11.2	Lv	4088.6	8.7	B
	4066.6	10.7	Lv	4099.9	8.6	Bi
	4076.6	10.0	Lv	4102.6	8.1	B
	4081.6	8.7	Pt			
205923 R VULPECULAE—						
	4052.6	11.3	Pt	4079.6	13.5	Ie
	4053.6	11.7	Ie	4081.6	7.5	Pt
	4058.7	12.4	Lv	4089.7	13.0	B
	4066.7	12.7	Lv	4090.6	13.2	Lv
	4075.7	13.2	Wf	4103.5	11.5	B
	4079.6	13.6	Lv	4104.6	11.9	Bi
210124 V CAPRICORNI—						
	3994.1	[13.0	Bl	4058.0	13.0	Bl
	4017.1	[13.0	Bl			
210129 TW CYGNI—						
	4053.5	12.7	Ie	4089.6	11.5	Y
	4056.6	12.6	Bi	4100.6	10.5	Ie
	4079.6	12.0	Ie	4103.6	10.4	B
	4088.6	11.1	B			
210221 X CAPRICORNI—						
	3994.1	13.7	Bl	4058.0	13.3	Bl
	4017.1	[12.7	Bl			
210382 X CEPHEI—						
	4096.6	11.7	B			
210504 RS AQUARII—						
	4048.5	13.0	L	4081.6	11.8	Pt
	4052.7	13.8	Ie	4087.6	11.8	B
	4056.7	13.2	Bi	4100.6	11.2	B
	4072.6	12.8	B	4104.5	11.0	Ie
	4079.5	12.1	Ie			
210516 Z CAPRICORNI—						
	4052.6	11.0	Pt	4081.6	12.1	Pt
	4060.6	11.3	Mz	4086.6	12.6	B
	4072.6	11.6	B	4105.6	13.5	B
210812 R EQUULEI—						
	4055.7	14.2	Wf	4063.6	[13.8	Bi
	4056.7	[13.8	Bi	4064.7	14.3	Wf
210868 T CEPHEI—						
	3954.0	6.2	Ik	4036.0	8.1	Ik
	3971.0	6.3	Ik	4037.0	8.1	Ik
	3973.0	6.2	Ik	4038.1	8.1	Ch
	3974.0	6.2	Ik	4041.0	8.2	Ik
	3975.0	6.3	Ik	4046.6	7.5	L
	3976.0	6.5	Ik	4047.6	7.8	Jo
	3978.0	6.5	Ik	4050.6	8.3	I
	3979.0	6.6	Ik	4052.6	8.0	Pt
	3980.0	6.7	Ik	4053.6	8.7	Wl

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
210868 T CEPHEI—Continued.						
	3984.1	6.6	Ik	4054.6	8.4	Al
	3986.0	6.6	Ik	4054.6	8.4	Ks
	3987.0	6.7	Ik	4055.6	8.5	I
	3990.0	6.9	Ik	4056.6	8.0	Jo
	3992.7	6.7	Al	4056.6	8.0	I
	3995.0	7.3	Ik	4057.1	8.3	Ch
	3998.0	7.3	Ik	4060.6	8.7	Mz
	3999.0	7.4	Ik	4062.6	8.8	I
	4000.0	7.4	Ik	4063.6	8.6	Mz
	4001.0	7.4	Ik	4064.7	8.7	Jo
	4002.0	7.4	Ik	4068.6	9.0	I
	4003.0	7.4	Ik	4070.5	8.8	Mz
	4003.9	7.4	Kk	4071.3	8.3	L
	4005.0	7.4	Ik	4075.8	8.9	Sg
	4006.0	7.4	Ik	4078.6	9.2	Al
	4007.0	7.4	Ik	4081.5	8.3	Pt
	4008.0	7.4	Ik	4082.6	9.8	Jo
	4009.1	7.5	Kk	4084.5	8.6	I
	4012.0	7.6	Kk	4085.6	9.6	I
	4016.6	6.7	Al	4084.7	10.7	Cy
	4019.9	7.9	Kk	4084.7	10.7	Hy
	4020.9	7.9	Kk	4089.6	9.9	Mz
	4020.0	7.6	Ik	4089.8	9.0	Sg
	4025.9	8.1	Kk	4091.6	9.6	Mz
	4028.1	8.1	Kk	4094.6	9.6	I
	4031.0	8.2	Kk	4096.6	9.2	B
	4035.0	8.1	Ik			
210903 RR AQUARII—						
	4048.6	9.7	Ie	4081.5	11.0	Pt
	4052.6	9.5	Pt	4089.6	11.9	B
	4076.5	10.8	Ie	4103.6	12.6	B
211614 X PEGASI—						
	4079.6	13.8	Ie	4091.7	13.7	B
	4081.5	12.2	Pt	4104.6	12.1	B
211615 T CAPRICORNI—						
	3994.1	[13.5	Bl	4071.6	[12.7	B
	4056.7	12.1	Br	4089.6	12.5	B
	4058.0	13.0	Bl	4105.6	12.4	B
	4066.7	12.0	Br			
212030 S MICROSCOPII—						
	3972.2	9.8	Bl	4003.1	10.3	Bl
	3981.9	9.9	Bl	4017.1	10.8	Bl
	3994.1	9.9	Bl	4058.0	[13.4	Bl
212814 Y CAPRICORNI—						
	3994.1	[13.2	Bl	4017.1	[12.9	Bl
	4003.1	[13.3	Bl	4058.0	[12.9	Bl
213244 W CYGNI—						
	4001.1	6.3	Kk	4045.9	6.3	Kd
	4004.9	6.5	Kk	4047.3	6.3	An
	4010.0	6.3	Kk	4053.9	6.4	Kd
	4013.9	6.2	Kk	4050.9	6.1	Kk
	4016.0	6.1	Kk	4054.9	6.2	Kk
	4019.9	6.0	Kk	4057.9	6.0	Kk
	4021.9	5.8	Kk	4058.3	6.5	An
	4023.9	5.7	Kk	4060.9	6.2	Kd
	4025.9	5.9	Kk	4067.3	6.5	An
	4027.9	9.6	H	4071.6	5.3	Cu
	4027.9	6.2	Kk	4072.9	6.4	Kd
	4028.0	6.3	Kd	4075.9	6.3	Kd
213244 W CYGNI—Continued.						
	4031.2	6.0	Kk	4078.5	5.7	Cu
	4035.1	5.9	Kk	4080.3	6.6	An
	4036.0	6.3	Kd	4084.0	6.5	Kd
	4038.9	6.0	Kk	4088.3	6.6	An
	4045.9	6.1	Kk			
213678 S CEPHEI—						
	4052.6	9.0	Hu	4077.8	9.0	Bi
	4052.6	8.5	Pt	4078.6	11.5	Cu
	4053.6	9.8	Wl	4081.5	8.5	Pt
	4054.6	9.5	Ks	4082.6	8.6	Hu
	4055.7	10.0	Cy	4082.7	8.5	Bi
	4056.7	9.8	Br	4084.7	11.0	Mz
	4059.7	9.7	Lv	4091.7	9.6	Cy
	4059.7	9.5	Bi	4091.7	9.4	Hy
	4059.7	9.8	Bi	4093.6	8.8	B
	4066.7	9.6	Lv	4099.6	8.5	Bi
	4072.6	9.9	Cy			
213753 RU CYGNI—						
	4052.6	8.7	Pt			
213843 SS CYGNI—						
	3972.6	10.2	Al	4072.6	11.2	Ks
	3986.6	11.9	Gd	4072.7	11.3	B
	3994.6	11.8	Gd	4073.5	11.3	Cu
	3998.5	9.0	We	4073.5	11.6	Ly
	4000.0	8.4	Nk	4073.5	11.7	Pt
	4001.3	8.4	Nk	4073.6	11.8	Lv
	4001.5	9.5	We	4074.5	11.5	Ie
	4003.4	10.2	We	4075.5	11.5	Pt
	4005.0	11.0	Nk	4075.6	11.5	Wf
	4005.5	10.8	We	4075.6	11.2	B
	4006.0	11.5	Nk	4075.6	11.1	Br
	4007.5	11.7	We	4075.6	11.5	Ie
	4008.0	11.6	Nk	4075.6	11.6	L
	4010.5	11.8	We	4075.6	11.2	Ks
	4015.0	11.2	Nk	4075.8	11.8	Sg
	4016.4	11.4	We	4076.5	11.3	Ly
	4019.5	11.9	We	4076.5	11.6	Pt
	4021.0	11.2	Nk	4076.6	12.0	Hu
	4022.8	11.1	Lv	4076.6	11.7	Br
	4023.4	10.9	Kl	4076.6	11.3	I
	4024.7	11.0	Sg	4076.6	11.6	Cy
	4026.5	10.8	We	4076.6	11.6	Hy
	4027.4	9.0	Kl	4076.6	11.4	Ie
	4027.4	8.4	We	4077.3	11.9	Ro
	4028.5	9.4	We	4077.6	11.6	Br
	4030.3	8.7	L	4077.6	11.4	Wf
	4032.1	8.3	Ch	4077.7	11.6	Bi
	4032.3	8.3	Kl	4078.3	10.9	Ro
	4033.3	8.4	Kl	4078.4	11.7	L
	4033.6	8.3	Ya	4078.5	11.8	Pt
	4034.3	8.5	Kl	4078.6	11.0	I
	4035.3	8.5	Kl	4078.6	11.8	Br
	4035.5	8.3	Ya	4078.6	11.5	Cu
	4038.1	8.5	Ch	4078.6	11.2	Ie
	4038.5	9.0	L	4078.6	11.0	I
	4040.3	9.2	L	4078.8	11.8	Sg
	4043.7	10.4	Wf	4079.6	11.5	Lv
	4045.1	10.8	Ch	4079.6	11.7	Ie
	4045.7	11.2	Wf	4079.6	11.4	Pt

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Star	J.D.	Est.Obs.	J.D.	Est.Obs.
213843	SS CYGNI—Continued.			
	4046.5	11.5 L	4079.6	11.6 Y
	4047.4	11.4 We	4080.6	11.2 Bi
	4047.5	11.6 Ie	4080.6	11.2 Br
	4047.5	11.5 L	4080.6	11.0 Lv
	4048.3	11.4 L	4081.5	10.4 Bi
	4048.6	11.9 Br	4081.6	10.5 Lv
	4048.6	11.8 Cy	4081.6	10.5 Ie
	4048.6	11.6 Du	4081.6	10.8 Ly
	4048.6	12.0 Hy	4081.6	9.0 Al
	4048.6	11.8 Ie	4081.6	10.2 Br
	4048.8	11.5 Wf	4081.6	10.6 Pt
	4049.6	11.8 Du	4081.7	10.4 Ms
	4049.6	11.8 Ie	4082.6	9.4 Bi
	4050.4	11.6 We	4082.6	8.7 Hu
	4050.6	11.6 Ie	4082.6	9.1 Ms
	4050.7	11.8 Ca	4082.6	8.8 Pt
	4051.4	11.7 L	4082.6	8.6 Cu
	4051.6	10.9 Hu	4082.6	8.6 Ie
	4051.6	10.6 Ks	4082.8	9.4 Bi
	4051.7	11.7 Pt	4082.8	9.3 Bi
	4051.8	11.2 Mz	4082.8	8.7 Cy
	4052.5	11.3 Ly	4082.8	8.6 Cu
	4052.6	11.3 Ie	4083.4	8.4 Cu
	4052.6	11.9 Pt	4083.5	8.7 Ms
	4052.7	11.5 Cy	4083.6	9.0 Bi
	4053.4	10.9 We	4083.6	8.6 Lv
	4053.5	11.2 Ie	4083.6	8.6 Ie
	4053.6	10.5 Ks	4083.6	8.7 Pt
	4053.6	11.7 Pt	4083.7	8.7 Cu
	4053.6	11.0 Wl	4084.5	8.6 Ms
	4053.7	11.0 Bi	4084.5	8.7 Ie
	4053.7	11.2 Lv	4084.6	8.7 Bi
	4053.8	11.4 Ca	4084.6	8.4 I
	4054.0	11.1 Nk	4084.7	8.7 Mz
	4054.5	11.8 Cy	4084.7	8.5 Ms
	4054.5	10.4 Ks	4084.8	8.7 Pt
	4054.5	11.0 Ly	4085.6	8.7 Hu
	4054.5	11.1 Ie	4085.6	8.8 Ie
	4054.6	11.8 Hy	4085.6	9.0 Lv
	4054.6	11.5 Pt	4085.6	8.8 I
	4054.7	11.0 Bi	4085.6	9.5 Pt
	4054.8	11.5 Wf	4086.6	8.8 Ms
	4055.1	10.8 Ch	4086.6	9.1 Ly
	4055.5	11.1 Ie	4087.5	9.4 Ms
	4055.5	11.0 Ws	4087.5	9.6 Cu
	4055.5	11.1 Mx	4087.5	9.2 Ly
	4055.6	11.0 Br	4087.5	10.2 Pt
	4055.6	11.6 Cy	4087.6	9.2 Mz
	4055.6	11.2 Ly	4087.6	9.8 B
	4055.6	11.7 Pt	4088.6	10.1 Lv
	4055.7	11.5 Ca	4088.6	9.5 Ly
	4055.7	11.5 Wf	4088.6	9.5 Ms
	4056.2	10.9 Ch	4088.6	10.4 Pt
	4056.2	11.4 Nk	4088.7	9.6 Mz
	4056.4	11.0 We	4088.7	9.9 B
	4056.5	11.1 Ie	4088.7	9.8 Cu
	4056.5	10.8 Ms	4089.5	10.1 Ie
	4056.5	10.9 Mx	4089.5	10.2 Ly
	4056.6	11.0 Br	4089.6	10.0 Ms
213843	SS CYGNI—Continued.			
	4056.6	10.5 Ie	4089.6	10.5 Pt
	4056.7	11.3 Wf	4089.6	9.7 Y
	4057.0	10.9 Ch	4089.6	10.0 Cy
	4057.5	11.1 I	4089.7	10.0 Mz
	4057.6	11.2 Wf	4089.7	10.1 B
	4058.5	11.3 Ms	4089.8	10.1 Sg
	4058.6	11.2 Mx	4089.8	9.8 Mx
	4058.6	11.3 Wf	4090.5	10.3 Y
	4058.7	10.9 Lv	4090.5	10.3 Ie
	4059.2	11.4 Ch	4090.6	10.7 Bi
	4059.2	10.9 Nk	4090.6	10.8 Lv
	4059.7	11.0 Lv	4090.6	10.4 I
	4059.7	11.4 Pt	4090.8	10.6 Pt
	4059.8	11.2 Mz	4091.5	10.6 Ie
	4060.5	11.5 Ie	4091.5	10.8 Ly
	4060.5	11.3 Ly	4091.6	10.6 Hy
	4060.6	11.5 Ms	4091.6	10.9 Mx
	4060.6	11.5 Pt	4091.6	10.6 Cy
	4060.7	10.9 Mz	4091.6	10.7 Mz
	4061.5	11.5 Ie	4091.6	10.9 Ms
	4061.5	10.8 Ks	4091.6	11.1 Bi
	4061.5	11.5 Pt	4091.6	11.0 Lv
	4061.6	11.3 Bi	4091.7	10.9 Pt
	4061.6	11.0 I	4091.7	11.0 B
	4061.7	10.9 Mz	4092.5	11.1 Pt
	4061.8	11.1 Ca	4093.5	11.1 Pt
	4062.2	11.6 Ch	4093.5	11.1 Ie
	4062.4	10.8 We	4093.6	11.0 Lv
	4062.5	11.5 Ms	4093.6	11.2 Mz
	4062.5	11.6 Pt	4093.6	11.6 Bi
	4062.6	11.2 I	4093.6	10.9 Cy
	4062.6	11.5 Ie	4093.7	11.0 B
	4062.7	11.6 Cy	4094.5	11.8 Pt
	4062.7	11.3 Mz	4094.5	11.5 Ie
	4063.3	11.6 Ch	4094.6	11.5 Ly
	4063.6	11.1 Br	4094.6	10.9 Cy
	4064.4	12.1 L	4094.6	11.3 B
	4064.5	11.6 Ie	4094.6	11.5 I
	4064.6	11.6 Br	4096.5	11.8 Pt
	4064.6	11.0 Ks	4096.6	11.1 B
	4064.7	11.8 Wf	4097.6	11.5 B
	4065.5	11.8 Pt	4099.5	11.8 Pt
	4065.6	11.7 Br	4099.6	11.6 Bi
	4065.7	11.8 Bi	4100.5	11.5 Ie
	4066.6	12.0 Br	4100.5	11.7 Pt
	4066.6	11.7 Lv	4100.6	11.5 B
	4067.5	11.8 Pt	4101.6	11.4 B
	4067.7	12.0 Cy	4102.5	11.7 Pt
	4067.8	11.8 Sg	4102.6	11.9 B
	4068.5	11.6 Ly	4103.6	12.0 B
	4068.5	11.8 Pt	4104.5	12.0 Ie
	4068.6	11.9 Br	4104.6	11.9 B
	4068.6	11.6 Ie	4104.6	11.6 Ly
	4069.5	11.8 Pt	4104.6	11.7 Bi
	4069.6	11.6 Ie	4105.6	11.7 B
	4069.6	11.9 Ks	4106.5	11.7 Pt
	4070.4	11.9 L	4107.5	11.6 Ie
	4070.5	11.6 Ie	4108.5	11.5 Ks
	4070.7	11.7 Pt	4108.6	10.5 Mh

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
213843 SS CYGNI—Continued.						
	4071.2	11.8	L	4108.6	11.3	Ly
	4071.5	11.6	Cy	4108.6	11.8	Pt
	4071.6	11.6	Bi	4108.6	11.5	Ks
	4071.7	11.8	Pt	4109.6	11.5	Ks
213937 RV CYGNI—						
	4051.6	7.0	Hu	4082.6	7.0	Hu
	4052.6	6.5	Pt	4101.6	8.7	B
	4081.5	6.5	Pt			
214024 RR PEGASI—						
	4055.7	13.9	Wf	4075.7	13.6	Wf
	4056.7	14.0	Br	4075.7	13.4	Br
	4064.7	13.7	Wf	4082.7	12.6	Cy
214247 R GRUIS—						
	3972.2	12.8	Bl	4017.1	9.1	Bl
	3994.1	12.1	Bl	4058.0	8.8	Bl
	4003.1	10.7	Bl			
215605 V PEGASI—						
	4052.6	12.2	Pt	4081.5	13.1	Pt
	4054.6	12.1	Cy	4081.7	13.5	Lv
	4056.7	12.3	Br	4081.7	13.5	Br
	4059.7	12.6	Bi	4084.7	13.4	Bi
	4059.7	12.5	Lv	4089.6	[11.5	Mz
	4066.7	12.8	Lv	4091.7	13.5	B
	4079.7	13.5	Lv			
215717 U AQUARII—						
	4052.6	11.5	Pt	4087.6	11.5	B
	4072.6	11.4	B	4100.5	11.5	B
	4082.5	11.5	Pt			
215934 RT PEGASI—						
	4052.6	10.1	Pt	4073.8	10.8	Sg
	4053.8	10.2	Bi	4079.7	11.6	Lv
	4053.7	10.7	Lv	4082.5	11.8	Pt
	4058.7	11.0	Lv	4088.8	11.2	Sg
	4063.7	10.3	Bi	4091.7	13.6	Bi
	4065.8	11.3	Lv	4104.7	13.2	Bi
	4072.7	10.6	Bi	4104.7	12.5	B
220133a RY PEGASI—						
	4052.6	11.9	Pt	4103.6	12.2	B
220133b RZ PEGASI—						
	4052.6	12.6	Pt	4082.5	12.4	Pt
	4056.7	13.2	Br	4082.5	12.0	Pt
	4064.7	13.5	Br	4103.6	12.4	B
	4077.6	13.3	Br			
220412 T PEGASI—						
	4055.7	[13.2	Br	4090.8	14.5	Pa
220613 Y PEGASI—						
	4052.6	13.7	Pt	4090.7	12.8	Lv
	4058.8	13.8	Lv	4090.6	16.	Pa
	4079.7	14.0	Lv	4101.6	12.5	B
	4084.7	13.9	Bi			
220714 RS PEGASI—						
	4052.6	10.8	Pt	4082.5	9.0	Pt
	4058.8	11.0	Lv	4084.7	8.9	Bi
	4071.7	9.4	Lv	4088.7	9.1	Lv
	4071.7	9.2	Bi	4090.7	9.0	Lv
	4071.7	9.4	Bi	4090.8	9.6	Pa
	4077.8	8.8	Bi	4101.6	8.9	B
	4079.7	9.4	Lv	4104.7	9.2	Bi
222129 RV PEGASI—						
	4056.7	11.3	Br	4101.7	11.0	B
222439 S LACERTAE—						
	4052.6	12.6	Pt	4072.7	11.6	Bi
	4053.6	12.9	Ie	4079.6	11.3	Ie
	4053.8	12.7	Bi	4079.7	11.5	Lv
	4053.8	12.9	Lv	4082.5	10.9	Pt
	4056.7	12.9	Br	4090.7	10.4	Lv
	4058.8	12.8	Lv	4100.6	9.9	Ie
	4065.8	12.6	Lv	4103.6	9.7	B
	4066.7	11.8	Br	4104.7	9.7	Bi
222867 R INDI—						
	3994.1	12.9	Bl	4017.1	11.6	Bl
	4003.1	12.0	Bl	4058.0	9.0	Bl
223841 R LACERTAE—						
	4056.7	12.0	Br	4082.7	10.8	Bi
	4058.8	12.3	Lv	4083.7	10.7	Lv
	4065.8	12.0	Lv	4087.7	9.8	Mz
	4072.7	11.2	Bi	4099.6	9.1	Bi
	4082.5	10.9	Pt	4104.7	8.9	Bi
225120 S AQUARII—						
	4079.6	10.3	Y			
225914 RW PEGASI—						
	4032.7	10.4	Sg	4076.5	12.8	B
	4052.6	11.5	Pt	4077.7	13.0	Br
	4056.7	12.0	Br	4082.5	13.1	Pt
	4064.7	11.9	Ie	4089.6	13.6	Ie
	4066.7	12.6	Br	4095.7	13.0	Sg
230110 R PEGASI—						
	4052.6	12.1	Pt	4077.7	13.0	Br
	4054.5	12.5	Ie	4081.6	13.0	Ie
	4056.7	12.5	Br	4082.5	12.6	Pt
230759 V CASSIOPEIAE—						
	4045.9	9.5	Kk	4076.6	9.5	B
	4048.6	9.5	Du	4077.7	10.6	Br
	4051.8	9.6	Mz	4078.3	12.2	Ro
	4052.6	9.4	Pt	4082.5	10.8	Pt
	4053.6	9.6	Wl	4082.7	10.7	Cy
	4054.5	9.5	Ca	4087.5	10.6	B
	4054.6	9.6	Cy	4087.7	11.0	Mz
	4060.7	10.4	Mz	4088.8	8.6	Sg
	4062.6	10.0	Cy	4094.6	11.0	Cy
	4075.8	10.5	Sg	4101.5	10.7	B
231425 W PEGASI—						
	4004.	11.4	Kl	4059.8	10.6	Lv
	4007.	11.4	Kl	4066.7	10.5	Lv
	4017.	11.4	Kl	4074.8	9.5	Lv
	4023.	11.4	Kl	4077.8	9.4	Bi
	4027.	11.3	Kl	4082.7	9.2	Bi
	4032.	11.3	Kl	4083.7	9.0	Lv
	4034.	11.2	Kl	4104.7	8.4	Bi
	4059.8	10.7	Bi			
231508 S PEGASI—						
	4052.6	12.2	Pt	4082.5	11.3	Pt
	4055.7	12.3	Br	4090.5	10.4	B
	4076.5	11.2	B			
232848 Z ANDROMEDAE—						
	4052.6	9.5	Pt	4082.5	9.5	Pt
	4057.1	9.6	Ch			

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Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
233335 ST ANDROMEDAE—						
	4031.7	8.9	Sg	4082.5	8.6	Pt
	4051.6	8.8	Hu	4084.7	9.1	Al
	4052.6	8.8	Pt	4085.2	9.0	Hu
	4055.1	9.1	Ch	4098.5	8.5	B
	4078.6	8.8	Al			
233815 R AQUARII—						
	4050.6	10.7	Ca	4081.5	10.7	Ms
	4052.6	10.4	Pt	4082.5	10.4	Pt
	4055.5	10.2	Ms	4082.6	10.7	Cu
	4055.6	10.2	Mx	4082.7	10.6	Ms
	4055.7	10.9	Ly	4084.5	10.7	Ms
	4056.2	10.3	Ch	4084.5	10.5	Mx
	4058.5	10.4	Ms	4087.5	10.4	Mx
	4058.6	10.4	Mx	4088.4	10.6	An
	4059.6	10.4	Mx	4088.6	10 3	Ms
	4060.5	10.5	Ms	4089.5	10.3	Mx
	4060.6	11.5	Ly	4091.5	10.3	Ms
	4060.7	10.4	Mz	4091.5	10.3	Mx
	4061.6	10.4	Mx	4103.5	10.1	Mx
	4062.5	10.5	Ms	4103.5	10.1	Ms
	4078.5	10.6	Ms	4104.5	10.2	Ms
	4078.5	10.6	Mx	4104.5	10.2	Mx
233956 Z CASSIOPEIAE—						
	4056.7	11.3	Wf	4079.7	11.4	Lv
	4064.7	11.2	Br	4089.5	11.7	B
	4064.7	11.4	Wf	4091.5	12 3	Ie
	4065.8	12.0	Lv	4091.7	12.2	Lv
	4068.6	11.7	Ie	4099.6	12.2	Bi
	4072.7	11.3	Bi	4101.5	12.3	B
	4075.7	11.7	Wf	4104.7	12.5	Bi
	4076.6	11.4	B			
235053 RR CASSIOPEIAE—						
	4047.6	11.3	Ie	4089.5	10.5	Ly
	4069.6	11.7	Ie	4093.6	13.0	Ie
	4076.6	12.0	B	4114.6	10.3	Ly
	4082.7	12.0	Cy			
235209 V CETI—						
	3972.2	10.0	Bl	4056.7	[13.6	Br
	3994.1	11.6	Bl	4077.7	[13.6	Br
	4003.1	12.1	Bl			
235350 R CASSIOPEIAE—						
	4054.6	11.7	Cy	4080.7	11.5	Bi
	4061.5	11.6	Ca	4085.7	12.2	Lv
	4064.7	12.0	Br	4088.7	11.0	Mz
	4065.8	12.1	Lv	4090.5	11.4	B
	4072.6	10.8	Bi	4090.7	12.2	Lv
	4074.5	10.5	Mz	4099.6	13.3	Bi
	4079.7	12.2	Lv	4104.7	11.6	Bi
	4080.7	12.3	Lv	4105.5	11.4	B
235525 Z PEGASI—						
	4048.7	11.3	Ie	4082.5	10.4	Pt
	4052.6	11.6	Pt	4104.5	10.0	Ie
	4078.6	10.9	Ie			
235855 Y CASSIOPEIAE—						
	4055.7	12.0	Br	4077.7	12.8	Br
235939 SV ANDROMEDAE—						
	4055.6	[12.9	Ie	4083.6	12.3	Ie
	4056.8	[13.1	Br	4084 8	[13.1	Bi
	4064.7	[13.1	Br	4085.7	13.2	Lv
	4065.8	[13.1	Lv	4094.5	[12.7	B
	4077.7	[13.1	Br	4104.7	[13.1	Bi
	4079.7	13.4	Lv			

Total number of stars observed	384
Total number of observations	4074

This double report is necessitated in order to bring the records to date, and contains all the unpublished data received to November 30, 1924.

The following observers have contributed to this double report: Allen, "Al"; Ancarani "An"; Baldwin, "Bl"; Berman, "Bi"; Bouton, "B"; Carr, "Ca"; Chandra, "Ch"; Chisolm, "Cm"; Miss Clough, "Cg"; Cilley, "Cy"; Cunningham, "Cu"; Dunham, "Du"; Gaebler, "Gb"; Godfrey, "Gd"; Hama, "H"; Henry, "Hy"; Hubbard, "Hb"; Hunter, "Hu"; Iedema, "Ie"; Ikeda, "Ik"; Inglis, "I"; Jones, "Jo"; Kanda, "Kd"; Kasai, "Kk"; Kearons, "Kr"; Kleis, "Ks"; Köhl, "Kl"; Lacchini, "L"; Leavenworth, "Lv"; Mrs. Lytle, "Ly"; Marks, "Mx"; Marshall, "Mh"; Miayazima, "Mj"; Mitchell, "Mz"; Mrs. Morris, "Ms"; Nakamura, "Nk"; Parkhurst, "Pa"; Peltier, "Pt"; Rhorer, "Ro"; Schüller, "Sh"; Skaggs, "Sg"; Waldo, "Wl"; Waterfield, "Wf"; Wetherbee, "We"; Yalden, "Ya"; and Miss Young, "Y".

LEON CAMPBELL, Acting Recording Secretary.

COMET AND ASTEROID NOTES.

Ephemeris of Comet c 1924 (Finsler).—The elements of Comet *c* 1924, published in *Lick Obs. Bull.*, **9**, 356, represent an observation on 1924, Oct. 7, by Jeffers, as follows:

	O—C
$\Delta\alpha \cos\delta$	—0.″2
$\Delta\delta$	+0.4

This orbit therefore appears sufficiently accurate for extending the ephemeris to facilitate observation of the comet after it shall become a morning object in December.

EPHEMERIS FOR GREENWICH CIVIL MIDNIGHT.

1925	True α	True δ	Log Δ	Br.
	h m s	° ′		
Jan. 1.0	17 12 59	—33 36.5		
3.0	17 14 46	—33 55.6	0.506	.012
5.0	17 16 30	—34 14.5		
7.0	17 18 12	—34 33.5	0.509	.012
9.0	17 19 51	—34 52.3		
11.0	17 21 28	—35 11.2	0.512	.011
13.0	17 23 02	—35 30.0		
15.0	17 24 33	—35 48.9	0.514	.010
17.0	17 26 01	—36 07.8		
19.0	17 27 27	—36 26.7	0.516	.010
21.0	17 28 49	—36 45.7		
23.0	17 30 08	—37 04.8	0.517	.009
25.0	17 31 23	—37 23.9		
27.0	17 32 35	—37 43.2	0.518	.009
29.0	17 33 44	—38 02.5		
31.0	17 34 48	—38 22.0	0.518	.008

The unit of brightness is that of September 26.

A. D. MAXWELL.

Lick Observatory Bulletin, No. 358.
November 30, 1924. Issued December 6, 1924.

Planet Baade (1924 TD).—Baade's new asteroid has received the provisional designation 1924 TD. The following new elements by A. C. D. Crommelin and by G. Stracke are given in the Copenhagen Circular No. 52:

ELEMENTS OF BAADE'S PLANET (1924 TD).

A. C. D. Crommelin.

With the observations Oct. 23 (Bergedorf), Nov. 3 and 17 (Greenwich).

T = 1924 Sept. 28.39002 M. T. Gr.

ω = 130° 36′ 0.″51
Ω = 216 27 50.81 } 1924.0
i = 26 7 25.70
ϕ = 32 31 35.36
log a = 0.424 3873
Period = 4.330 928 years

G. Stracke.

With the observations Oct. 23 (Bergedorf), Nov. 8 (Heidelberg, Milano, Frankfurt) and Nov. 24 (Babelsberg).

1924 Nov. 1.5 M. T. Gr.

M = 7° 43′ 27.″9
ω = 130 35 43.8
Ω = 216 26 19.0 } 1924.0
i = 26 9 4.0
ϕ = 32 37 35.5
μ = 815.″063
log a = 0.425 876

The following ephemeris, computed by Dr. G. Stracke, is given in the Copenhagen Circular No. 53:

EPHEMERIS OF BAADE'S ASTEROID (1924 T D).

1925		True α	True δ	Log Δ	Log r	Mag.
		h m s	° ′			m
Jan.	6	1 33 37.6	—4 38.65	0.0874	0.2120	11.7
	7	36 0.8	4 35.16			
	8	38 23.0	4 31.48			
	9	40 44.3	4 27.60			
	10	43 4.6	4 23.54	0.1080	0.2188	11.8
	11	45 23.9	4 19.30			
	12	47 42.4	4 14.89			
	13	50 0.0	4 10.32			
	14	52 16.9	4 5.59	0.1281	0.2256	12.0
	15	54 33.0	4 0.72			
	16	56 48.3	3 55.71			
	17	1 59 2.9	3 50.58			
	18	2 1 16.7	3 45.33	0.1476	0.2324	12.1
	19	3 29.8	3 39.97			
	20	5 42.1	3 34.49			
	21	7 53.8	3 28.91			
	22	10 4.8	3 23.22	0.1665	0.2391	12.2
	23	12 15.2	3 17.44			
	24	14 25.0	3 11.56			
	25	16 34.3	3 5.60			
	26	18 43.0	2 59.57	0.1848	0.2457	12.4
	27	20 51.2	2 53.46			
	28	22 58.9	2 47.29			
	29	25 6.2	2 41.05			
	30	27 13.0	2 34.75	0.2025	0.2523	12.5
	31	29 19.4	2 28.40			
Feb.	1	31 25.4	2 22.00			
	2	33 31.1	2 15.57			
	3	2 35 36.5	—2 9.10	0.2197	0.2587	12.6

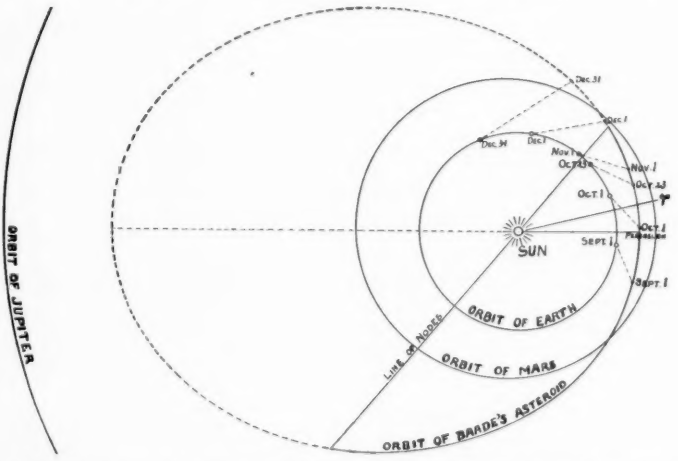


Diagram showing the orbit of Baade's asteroid (1924 TD) in relation to the orbits of Earth, Mars, and Jupiter.

The accompanying diagram shows the relation of the orbit of the planet to those of Earth, Mars and Jupiter. To get a true picture of the orbit the reader must think of it as being inclined 26° to the plane of the paper, rotated about the line marked "line of nodes." The dotted portion of the ellipse is below the plane of the earth's orbit and the smooth part above. It will be seen that the planet has been moving with very nearly the same speed as the earth and somewhat behind it in its motion. It might have been discovered a month or two earlier than it was, had anyone happened to take a photograph of the proper region.

New Object Discovered by Wolf.—A cablegram from Copenhagen received at Harvard College Observatory, December 27, announces the discovery of a sixteenth magnitude object by Wolf, December 23.3442; right ascension $4^h\,08^m\,19^s.5$; declination north 24° 31′ 36″; daily motion 28ˢ west, 14′ south.

COMMUNICATIONS.

Mercury and Venus, January 16 - February 5. — Since Mercury is not far from Venus on the mornings of January 16 to 24, a statement of the relative positions during that interval may be of interest, since it seems to be rather unusual. On the morning of January 16, Mercury is to be seen a degree and one-tenth from Venus, nearly north of it. On January 24 Mercury will be about 70 minutes of arc from Venus, nearly west of it. A plot has been made of the relative positions of these planets for alternate mornings, from January 16 through January 24; it shows that if a quadrant of a circle be drawn from Venus as center, with radius of 67 minutes of arc, Mercury will be near some point on this quadrant on each morning. The stellar magnitude of Mercury will be 0.0 at this time, that of Venus being —3.4. Hence Venus will be 23 times as bright as Mercury. Jupiter will be near by, being 4½ degrees east of Venus on January 16 and 3½ degrees west on January 24. It will be 3.6 times as bright as Mercury. It will be only about one-half degree east of Venus on the morning of January 20, and will be a little nearer, but west of Venus, on January 21.

On account of the times when the sun and these planets rise, a good time to look for them will be 6:15 A. M. or somewhat later. On the morning of January 21, the three planets will be more closely grouped together. The narrow crescent of the moon will join the show on the morning of January 22, being then some 7 degrees from the planetary assemblage, and west of it. The fourth magnitude star, Mu Sagittarii, will be nearest to Mercury on the morning of January 16, being three-fourths of a degree northeast of it, and one-fortieth as bright. Vega will be approximately in line between our group of planets and Polaris, during the days considered; while really a little fainter than Mercury, it will doubtless appear brighter because of its greater altitude.

The positions of Mercury with reference to Venus from January 28 to February 5, as seen in the morning sky, may be represented closely by an arc of a circle, having for its center a point two degrees north and half a degree east of Venus; its radius is two degrees and two-thirds. If one wishes to make a plot of the relative positions of these planets from January 16 to February 5 on squared paper, he may use the following approximate data, which are in the sense Venus minus Mercury. Mercury is north of Venus for January 16-24, and south

for the rest of the time. It is west of Venus for all the dates given, except February 3 and 5.

	$\Delta\alpha \cos\delta$	$\Delta\delta$		$\Delta\alpha \cos\delta$	$\Delta\delta$
Jan. 16	+ 4′	−67′	Jan. 28	+55′	+16′
18	36	52	30	40	25
20	56	37	Feb. 1	+21	33
22	67	22	3	− 3	38
24	69	− 8	5	−30	+41
26	+65	+ 5			

The two planets are in conjunction on Feb. 3.

H. A. Howe.

Chamberlin Observatory, University of Denver.
Denver, Colorado, December 12, 1924.

A Microscopical Device of Assistance to Telescopists.—I wish to call the attention of telescopists to a device of value to them when they have visitors to whom they wish to show the moon. It is known to microscopists as a "Demonstrator," and consists of an "L" shaped tube with a mirror set at an angle of 45 degrees in the angle, and two oculars affording direct and indirect views of any object simultaneously.

The chief advantage of the instrument lies in the fact that the person who views the object directly has under his control a pointer set in the ocular which can be turned in any direction, thus he is able to direct the other observer's attention to any object of interest on the slide.

By simply fashioning an adapter, the instrument can be attached to the telescope in a moment, and the person observing directly can then, if the moon is being observed, point out all the lunar features of interest.

Every telescopist realizes the difficulty of directing another observer's attention to particular objects of interest on the moon. The "Demonstrator" eliminates all uncertainty.

The device would also be useful in observing occultations of stars or planets by the moon, the phenomena of Jupiter's satellites, and in the observation of variable stars. It would permit of two independent estimates of a star's brightness being made simultaneously, under identical conditions of "seeing," which in some cases might be advantageous.

William Tyler Olcott.

Norwich, Connecticut.

Coral Origin of the Lunar Craters.—In the November issue of Popular Astronomy, I note the communication from Mr. P. R. Chidambara Iyer of the Kodaikanal Observatory of South India, commenting favourably on my paper, the "Limelight of the Moon." His letter has afforded me a strong additional argument in the theory of tidal evolution advanced by the late Sir Francis Darwin, which he mentions in this connection. The close similarity between the diagram of Keeling atoll given at Fig. 2, Plate ii, facing p. 38 of Darwin's "Coral Reefs" (Joseph W. Williams' London edition) and certain large irregular formations such as Stöfler, Goldschmidt (near the N. lunar pole), Plato, Fracastorius, etc., conclusively proves the coral origin of these "craters." The five ramparts of Copernicus could not have been formed by any other process than the secular growth of corals and their successive sinkings beneath the ancient Imbrian sea.

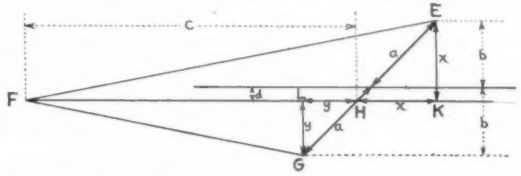
One fact should be patent, that the carbon dioxide evolved by the lungless

coral polyps unites with water in their cells, forming the animal carbonic acid—H_2CO_3. Calcium in the protoplasm of the cells, coming in contact with this acid is precipitated as calcium carbonate, $CaCO_3$,—bone or limestone from the cells.

I do not believe that the impact theory which I reviewed in 1917 is competent to explain the structure of craters like Copernicus, that have the rim reefs, inner rings, tide gates, central peaks and lagoons of such mundane atolls as Clermont-Tonnerre, for instance. Volcanism is merely a "by-product" of organic processes initiated by coral life, and the older geologies in making distinction between the recent sedimentary strata and the ancient igneous rock strata have committed a serious blunder, as the latter is merely a more ancient phase of the former.

3000 East 12th St., Kansas City, Mo. DONALD P. BEARD.

An Adjustment of the Flat Mirror in a Reflecting Telescope.—In order that the axis of the cone having for base the flat and for vertex the focus be coincident with the optical axis in a Newtonian telescope, the center of the flat, hence the axis of its cell, must be offset a certain distance d from the optical axis in a direction opposite to that of the ocular. To calculate the offset d, let $2a$ be the transverse axis and $2b$ the conjugate axis of the clear aperture of



the flat, and let c be the distance FH from the focus F to the point H where the optical axis intersects the working surface of the flat. From the right isosceles triangles EHK and GHL,

$$x\sqrt{2}+y\sqrt{2}=2a \qquad (1)$$

From the similar triangles EFK and GFL,

$$x/(c+x)=y/(c-y) \qquad (2)$$

Solving (2) for y, substituting its value in (1) and solving (1) for x,

$$x=\tfrac{1}{2}(\sqrt{4b^2+c^2}-c)+b$$

Then

$$d=x-b=\tfrac{1}{2}(\sqrt{4b^2+c^2}-c)$$

D. F. BROCCHI.

4331 Thackeray Place, Seattle, Wash. Dec. 14, 1924.

GENERAL NOTES

Dr. H. Seeliger, of Munich, died on December 2, at the age of 75 years.

Professor A. Biehl has retired from the Astrophysical Observatory at Potsdam, having reached the age limit, and Dr. Baron von der Pahlen has been appointed to take his place. (*Science*, December 12, 1924.)

Photographic Studies of Mars.—In the October number of the *Pub. Ast. Soc. Pacific*, Prof. W. H. Wright of the Lick Observatory describes an attempt to study Mars by photographing the planet with the Crossley reflector through screens transmitting only limited regions of the spectrum. His conclusions, which he terms tentative, may be summarized as follows:

1. Infra-red photographs show planet proper; violet ones show the atmosphere; yellow ones show visual aspect, which is a combination of the first two.
2. Mars possesses an atmosphere of appreciable absorbing and light-scattering power.
3. Atmosphere probably at least 120 miles in depth.
4. Atmosphere might appear yellow or orange by transmitted light.
5. The south polar cap is an atmospheric phenomenon of which we see only the upper surface.

This work of Prof. Wright's has opened many additional questions concerning Mars. Those interested should read the original paper in order to understand more clearly the observational methods and lines of thought leading to the above conclusions.

Rotational Effect on the Spectra of Binary Stars.—We are glad to publish the following note, sent in by one who is competent to judge as to the question of priority of discovery of the effect mentioned.

"Your reviewer who discussed the papers by Rossiter and McLaughlin in the July number of the *Astrophysical Journal* comments on the discovery of the rotational effect for those two stars. I notice elsewhere considerable comment on the same phenomenon. I believe the discoverer of the effect is Professor Schlesinger who, in 1909, clearly stated the matter (cf. *Allegheny Observatory Publications*, **1**, p. 134). I believe he has also mentioned it since and has observed it in other stars (λ Tauri, δ Librae)."

AFTER THE SNOW STORM.

No moon or clouds, no breeze; yet out of door
Deep snow-drifts lie,—another storm is o'er.

Capella glitters gem-like overhead;
Aldebaran is gleaming weird and red.

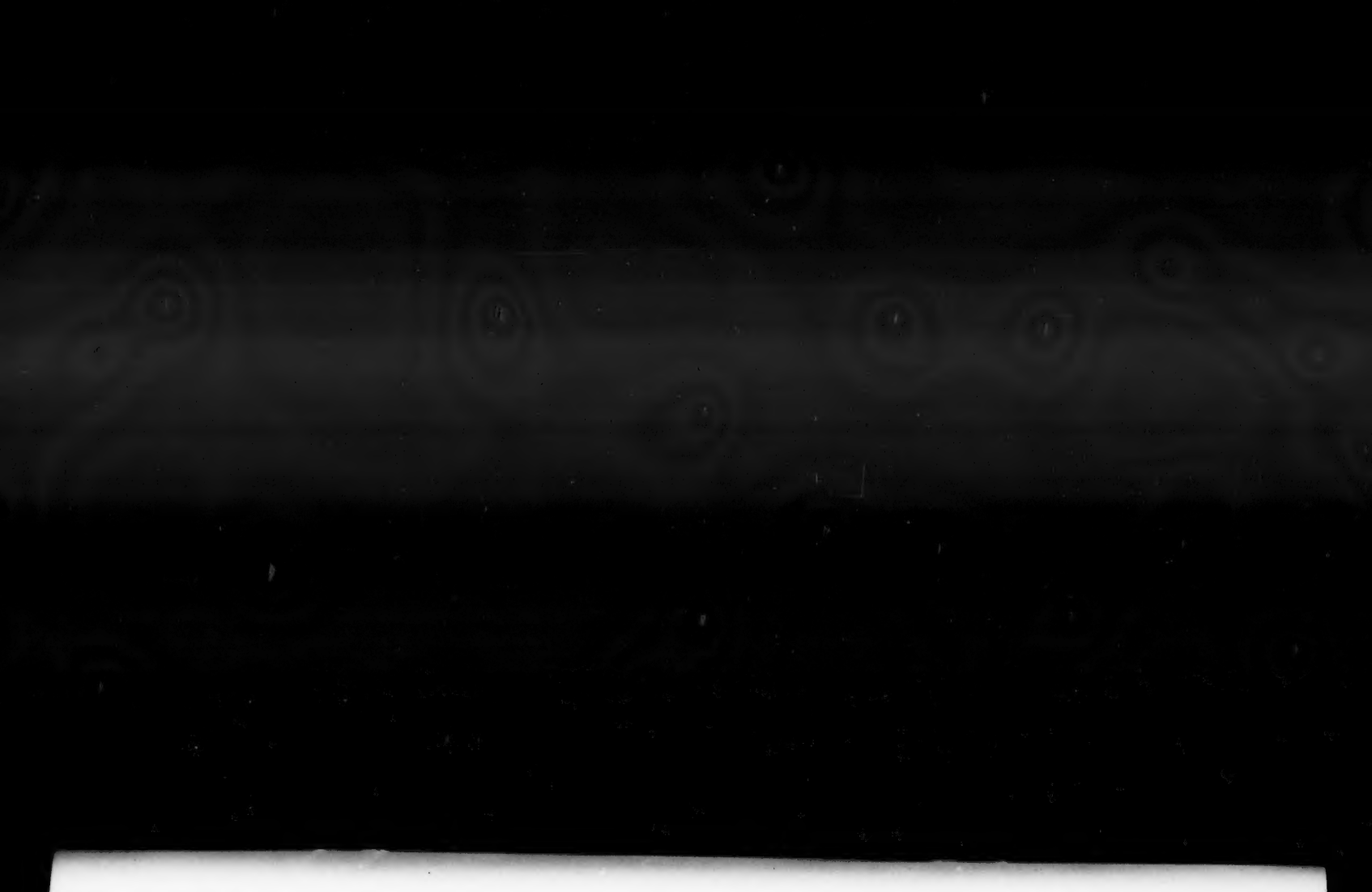
The Pleiades adorn a flawless sky,
And, eastward, glow the Twins in Gemini.

Like firmamental star-king, all alone,
Reigns Procyon upon a golden throne.

Although these beacons burn with brilliant rays,
Orion's beams with greater glories blaze;

There, Betelgeuse and Rigel grandly shine
And Belt-stars glimmer in their starry line.

And, southwardly, above Earth's drifts of snow,
Canicula the dog-star sparkles low.

CHARLES NEVERS HOLMES.

41 Arlington St., Newton, Mass.